THE UNIVERSITY OF CHICAGO
FOUUNDED BY JOHN D. ROCKEFELLER

INVESTIGATIONS REPRESENTING THE DEPARTMENTS

ASTRONOMY AND ASTROPHYSICS

THE DECENNIAL PUBLICATIONS
FIRST SERIES VOLUME VIII

CHICAGO
THE UNIVERSITY OF CHICAGO PRESS
1903

CONTENTS

PREFATORY NOTE

The articles which constitute this volume of the Decennial Publications will appear also as the second volume of the *Publications of the Yerkes Observatory*. The requirements of the tabular matter, and the desire to preserve as far as possible the format of the regular publications of the Observatory, are responsible for the modification of the type-page adopted for the other volumes of the series.

The Editorial Committee.

MEASURES OF DOUBLE STARS

MEASURES OF DOUBLE STARS WITH THE 40-INCH REFRACTOR OF THE YERKES OBSERVATORY IN 1900 AND 1901

S. W. BURNHAM

THE double-star measures recorded here were made principally in the years 1900 and 1901. The observations preceding this period were almost entirely of the β stars; and the mean results have been incorporated in the "General Catalogue of 1290 Double Stars" discovered by the writer from 1871 to 1899, and issued in 1900 as Vol. I of the *Publications of the Yerkes Observatory.* The detailed measures have not been printed, but, as the results have been given in connection with all the measures of these stars, arranged in chronological order, I have not thought it worth while to give the separate observations.

In making the working-list of objects for measurement, the purpose was to include no star likely to be observed elsewhere, and to confine it wholly to long-neglected and little-known pairs, and those which for the lack of sufficient measures, or the uncertainty of the early results, could not be classified as to motion or otherwise. These stars, so far as the early astronomers are concerned, come largely from the several catalogues of the two Herschels and South, with some of the rejected Struve pairs also catalogued and roughly measured by Herschel II. Many of these, and particularly those from Herschel I. and South, are wide pairs, and too widely separated to be considered by modern observers as double stars in the proper sense of the term; and, whenever change has been found in this class of objects, it is very probable that it is due to the proper motion of one or the other of the components. In the other class, where the distances are less, the changes, if confirmed by later observations, may point to physical systems, though, of course, the orbital movement would of necessity be slow. It seemed very desirable that these stars, among the oldest known so far as the literature of the subject is concerned, and observed by the most eminent astronomers who have ever lived, should receive sufficient attention from modern observers to show whether or not in this long interval there has been any relative motion. In many instances the measures now made do not satisfactorily determine this, since the apparent change may be accounted for by errors in the single observations made when the pair was first catalogued, and another series of measures at some later time may be necessary.

It will be seen that in many of these stars there are great apparent changes, and it is practically certain, after making all due allowance for the early observations, that many of these changes are real. The measures of Herschel II. consist usually of a single reading for the position-angle and an estimate of the distance. The angles are generally very accurate, so far as one can judge from the better-known class of stars catalogued by him; but the distances, and particularly those which are under 10″, would seem to be very frequently underrated, so that many of the apparent changes in this respect will probably not prove to be real. The observations were all made seventy or eighty years ago, and, with few exceptions, these pairs have been entirely neglected since that time. A slow movement of any kind would make a decided change in the relation of the components after such an interval of time. Another set of measures twenty or thirty years hence will dispose of the question of motion and eliminate many of these objects with respect to any further attention.

The neglected pairs of Herschel I. and South belong largely to the wider classes, and therefore were not incorporated by Struve in *Mensurae Micrometricae.* Some of the pairs of the first observer have not been observed at all since that time, the interval being about a century and a quarter. The measures of South were made about 1825, and the objects taken from his catalogue have either not been measured since at all, or the later measures indicate some change.

Another class of stars selected for measurement has been taken from various star catalogues where

the star was noted as double by the meridian observer. These catalogues include Weisse, Argelander, Harvard Zones, some of the A. G. catalogues, and others. These pairs have not been previously measured. Some of them are likely to prove to be physical pairs.

Some of the neglected OΣ stars were put on the list, but on the appearance of Hussey's complete re-observation of all the Poulkowa stars (*Publications of the Lick Observatory*, Vol. V) further measures were unnecessary, and this part of the work was discontinued. The wide pairs noted by OΣ, which correspond to similar pairs given in Appendices I and II to the *Mensurae Micrometricae*, of which there are no measures since the observations of Dembowski, some twenty-five years ago, have been measured to ascertain whether or not there has been any change since that time.

A further class of pairs has been taken from more modern works, which include some of the pairs recorded by the several observers at the Cincinnati and Harvard College Observatories, and others still more recently catalogued. Many of these were given only approximate places and a single measure for the relative position. In all cases the error of place has been corrected, and the object identified in the D. M. or some other star catalogue. In a few instances the pair could not be found at all after a careful search in the vicinity of the assigned place.

The observing-list of stars selected in this way would obviously be a long one, and the work laid out is far from being finished. The observations which follow, amounting to about fifteen hundred measures, include only the pairs which have been measured on at least two nights. Those which have been measured once only must be given in a later series. A large number of pairs are still to be measured for the first time.

The method of making the measures has been too often described to need repeating here, since it is practically the same with all observers who use the micrometer. Double distances have, of course, been taken, and a sufficient number of readings made, usually three to five, to give as good a mean as the observer can attain. From a large number of transits, and measures of difference of declination of well-determined stars, by Professor Barnard and myself, the value of 9″.666 for one revolution of the micrometer has been adopted.

In the course of these observations a few new pairs have been picked up, which are given at the end of the other measures. These are numbered in continuation of my prior lists from 1291 to 1308 inclusive. The reason why this number of new pairs is not larger will be readily understood when it is explained that, in the first place, the finding of new pairs was no part of the work planned, and no time was spent in the examination of adjacent stars; and, in the second place, for all stars smaller than 7.5 magnitude, diagrams were carefully platted to scale from the D. M. catalogues, showing the place of the pair sought and all the other stars in the vicinity, down to the Argelander limit, within a radius of about one degree. This preparation was essential in the interest of saving time in finding the object, and for the purpose of properly identifying it. Hence, except in cases where the given place was erroneous, the proper star could be placed in the field at once without loss of time, and no attention given to the other stars in the neighborhood. With any other plan, doubtless, a large number of new pairs, of more or less apparent interest, would have been found, but necessarily it would have seriously interfered with the carrying out of the arranged program, which would require at least several years thoroughly to complete; and it seemed much more important at this time to correct the descriptions and places of the stars recorded by some of the first observers, and get data for learning something of the movement of these long-neglected pairs. The old and well-known double-star systems are in no danger of being overlooked, and there has always been an unnecessary duplication of the measures of these pairs.

The star-places given are for 1880.

I. MEASURES OF KNOWN DOUBLE STARS

Σ 3065 *rej.* S.D.(15°)3. 8.6 . . . 8.7

R.A. = 0h 1m 51s
Decl. = − 14° 54′

1901.796	289°2	9″44
.854	289.1	9.55
1901.82	289.1	9.49

No other measures of this pair.

Σ 3064 *rej.* 7.2 . . . 10.4

R.A. = 0h 2m 10s
Decl. = + 39° 26′

1901.722	358°1	23″91
.796	356.4	23.80
1901.76	357.2	23.85

The only other measures are by H, 351°1 : 20″ ± (1830).

β *Cassiopeiae.* 2 . . . 15

R.A. = 0h 2m 43s
Decl. = + 58° 29′

1900.684	204°5	22″88
.725	204.0	22.44
1900.70	204.2	22.66

The only other measures of the Clark companion are my own in 1889. The principal star has a proper motion of 0″550 in 110°2. This movement, with the measures of 1889, gives the position of the small star for the date of the above measures, 204°8 : 22″28. It is therefore certain that the companion is fixed in space.

O.Arg.N.21. 8.8 . . . 8.8

R.A. = 0h 2m 51s
Decl. = + 58° 58′

1901.818	145°1	23″44
.835	144.6	23.26
1901.82	144.8	23.35

"Duplex" in O.Arg. No other measures. These stars are D.M.(58°)4 and 5. The A.G. positions give 143°6 : 2″592 (1873.7).

H 1001. D.M.(43°)7. 8.5 . . . 9.1

R.A. = 0h 2m 57s
Decl. = + 44° 3′

1901.722	77°5	15″80
.758	77.7	15.72
1901.74	77.6	15.76

The R.A. in H is 1m too large. He gives 84°5 : 13″ ±. No other measures.

H 1939. 8 . . . 9.3

R.A. = 0h 3m 41s
Decl. = + 10° 45′

1901.605	161°2	34″75
.742	161.3	35.09
1901.67	161.2	34.92

The Decl. in H is 5′ too small. By a single measure in 1877 I found 159°1 : 36″08.

Σ 3. *Andromedae* 51

R.A. = 0h 3m 49s
Decl. = + 45° 43′

1901.722	83°4	4″87
.758	83.4	4.79
1901.74	83.4	4.83

H notes another small star, 133°0 : 4″57, and says: "Possibly the small star is a mere illusion." I could not see anything of it here, or attached to any star in the vicinity. No change in the Σ components.

Σ 6 *rej.* D.M.(4°)9. 8.9 . . . 10.5

R.A. = 0h 4m 6s
Decl. = + 4° 13′

1901.605	192°8	21″20
.742	192.7	21.02
1901.67	192.7	21.11

The only other measures are by the Harvard observers, 193°2 : 22″56 (1869.92) 1*n*.

H 617. D.M.(0°)9. 9.2 . . . 12.7

R.A. = 0h 5m 4s
Decl. = + 0° 36′

1900.706	61°8	13″57
0.744	59.2	13.39
1.742	60.9	13.13
1901.06	60.6	13.36

H gives 55° ± : 6″ ± : 9 . . . 14, and says "a third 18m at 4″ : 320° suspected." I could not see any other companion.

H 618. D.M.(−0°)17. 9.6 . . . 9.6

R.A. = 0h 7m 22s, Decl. = − 0° 47′

1901.742	249°6	5″33
.854	71.4	5.16
1901.80	250.5	5.24

No other measures; 250°± : 2″± (1820) H.

H 1947. 7.3 . . . 10.5

R.A. = 0h 10m 3s, Decl. = + 42° 58′

1901.818	75°6	9″14
.835	75.1	9.06
1901.82	75.3	9.10

The principal star (Radcliffe 44) has a small proper motion (*Mon. Not.*, LI, 398).

1879.40	74°6	9″36	2*n*	OΣ

W² 0.264. 8.5 . . . 8.5

R.A. = 0h 11m 10s, Decl. = + 35° 10′

1901.835	107°0	5″34
.854	107.6	5.25
1901.84	107.3	5.29

"Duplex 4″ distance" in Weisse. The only measure is:

1879.61	106°4	5″35	1*n*	Cin

H 1951. S.D.(12°)44. 8.6 . . . 12.0

R.A. = 0h 12m 41s, Decl. = − 11° 37′

1901.796	217°9	22″72
.854	217.1	23.03
1901.82	217.5	22.87

The only complete measure preceding this is:

1877.95	216°6	24″09	1*n*	β

H 1953. ι *Ceti.* 4 . . . 12

R.A. = 0h 13m 19s, Decl. = − 9° 30′

1900.666	17°0	63″00
.668	17.1	62.75
1900.66	17.0	62.87

The other measures are:

1880.31	15°5	61″96	2*n*	β

The principal star has a very small proper motion, 0″057 in 236°0.

Hd 17

R.A. = 0h 18m 32s, Decl. = − 0° 37′

Described in the Harvard observations, *sp* : 10″ : 8 . . . 12. This star is not double, and no such pair found in the vicinity (1901.74).

OΣ 10 *rej.* L 581. 6.3 . . . 8.9

R.A. = 0h 21m 16s, Decl. = + 15° 22′

1901.742	237°6	100″55
.854	238.0	100.96
.873	237.8	100.97
1901.82	237.8	100.83

The first measure of this distant star is:

1866.68	237°0	96″34	3*n*	⅃

The A.G. proper motion of the principal star is 0″092 in 286°2. The above measures give 0″133, so that the first is too small, or the other star has a movement of its own.

H 322. 12 *Ceti.* 6.5 . . . 11.7

R.A. = 0h 23m 55s, Decl. = − 4° 37′

1901.760	189°4	9″70
.815	188.4	9.52
.818	188.8	9.40
.835	189.6	9.53
1901.81	189.0	9.54

The only measures are:

1866.76	185°2	8″66	3*n*	⅃
1880.23	187.0	8.63	3*n*	β

The proper motion of A is practically zero.

β 107

R.A. = 0h 24m 31s, Decl. = + 62° 41′

A and B

1900.706	354°9	5″71
.725	353.2	5.69
1900.71	354.0	5.70

A and C

1900.706	336°7	46″94
.725	336.7	46.62
1900.71	336.7	46.78

A and D

1900.706	146°.5	50″.28
.725	146.6	50.36
1900.71	146.6	50.32

A and E

1900.706	170°.9	113″.59
.725	170.8	113.51
1900.71	170.9	113.55

A and F

1900.706	114°.1	150″.50
.725	113.7	150.48
1900.71	113.9	150.49

E and *e*

1900.725	139°.1	8″.61	16*m*

(See *Popular Astronomy* for December, 1900.)

H 1982. 52 *Piscium*. 6 . . . 12

R.A. = 0h 26m 18s
Decl. = + 19° 38′

1900.684	304°.2	41″.08
.687	304.1	41.28
1900.68	304.2	41.18

The only measures are:

1830 +	309°.6	25″±	1*n*	H
1879.99	305.7	38.30	3*n*	β

The distance would seem to be increasing. The proper motion is very small, 0″.012 in 109°.3.

H 1038. 10.7 . . . 10.8

R.A. = 0h 29m 19s
Decl. = + 63° 4′

1901.722	111°.0	3″.77
.818	109.3	3.81
1901.77	110.1	3.79

The only position is by H, 97°.0 : 1½″ (1828); "in contact with 160; just separated with 240." I looked this up in 1876 with the 6-inch, and estimated the distance as fully 2″. Not in D.M.

H 1040. 10.9 . . . 11.2

R.A. = 0h 31m 37s
Decl. = + 65° 7′

1901.722	355°.4	4″.88
.796	353.3	5.18
1901.76	354.3	5.03

H gives 356°.4 : 2″± (1830).

H 3380.

R.A. = 0h 33m 35s
Decl. = − 17° 23′

H gives 96°.2 : 30″± : 7½ . . . 13 (1836.78). There is no bright star in this place, and I could not find any such pair in the vicinity. It may be identical with H 2067, which is 1h more R.A. The descriptions agree.

D.M. (−0°)75. 7.6 . . . 11.5

R.A. = 0h 31m 56s
Decl. = − 1° 10′

1901.703	307°.1	30″.46
.873	306.5	30.50
1901.79	306.8	30.48

This was measured for Σ 53 *rej.* No other observations. The principal star is 6.8m in D.M., and has a proper motion of 0″.087 in 253°.4.

Σ 53 *rej.* 8.0 . . . 8.7

R.A. = 0h 37m 18s
Decl. = − 1 32′

1901.735	338°.9	27″.79
.854	338.3	27.61
1901.76	338.6	27.70

The earliest measures are:

1891.81	334°.6	26″.47	3*n*	Engelhardt

This star has a considerable proper motion; 0″.415 in 216°.6 (Porter); 0″.301 in 228°.4 (Nico. A.G.). The smaller star is probably not moving with the other.

H 1051. 11 . . . 13.2

R.A. = 0h 38m 11s
Decl. = + 24 3′

1900.706	221°.0	6″.52
.780	221.2	6.88
1900.74	221.1	6.70

The distance seems to be greatly overestimated by H, as in nearly every instance of this kind. He gives 275°.0 : 1½″ : 10 . . . 14 (1828). It is near D.M. (23°)98.

H 626. D.M.(30°)110. 8.5 . . . 11 . . . 12.5

R.A. = 0h 39m 7s
Decl. = + 31° 1

A and B

1901.703	315°.9	32″.16
.758	316.4	32.46
1901.73	316.1	32.31

B and C

1901.703	105°8	10″51
.758	107.1	10.16
1901.73	106.4	10.35

H gives 330 ± : 20″ ± : 9 . . . 14; "large star, very red." The third star was not seen by him. A is only yellowish at most.

H 1054. D.M.(59°)125. 8.2 . . . 10.5

R.A. = 0h 42m 31s
Decl. = + 60° 6′

1901.796	182°5	8″75
.799	181.6	8.58
1901.80	182.0	8.66

H gives 176°0 : 5″ ± : 9 . . . 13 (1828).

Hd 35. S.D.(2°)110. 8.7 . . . 9.3

R.A. = 0h 42m 28s
Decl. = − 2 25′

1901.835	37°1	6″86
.873	37.0	6.99
1901.85	37.0	6.92

From the Harvard list. The only measure is:

1867.89	37°4	7″04	1*n*	Hd

Hd 36

R.A. = 0h 43m 10s
Decl. = − 21° 48′

This is in the Harvard list as O.Arg.S.439, with the correct place as given above. The description is 16°6 : 21″ : 7 . . . (1868.82). This star is not a double of any kind, nor is there any pair as described in the vicinity. The nearest pair is *β*301, but this does not correspond in any respect to measures or magnitude.

OΣ (App) 9. 8 . . . 8.2

R.A. = 0h 43m 21s
Decl. = + 29° 48′

1901.703	236°8	96″72
.799	236.5	96.10
1901.75	236.6	96.41

The principal star has a proper motion of 0″263 in 100°3 from meridian positions. The measures of Δ in 1875 compared with the foregoing give 0″217 in 92°1. There is a 12m star nearly midway, from **A** 252°7 and from B 42°5.

H 628. 7.7 . . . 11.5

R.A. = 0h 45m 25s
Decl. = + 33° 14′

1901.703	68°5	42″73
.796	68.8	42.51
.799	69.0	42.53
1901.76	68.8	42.59

H gives 65° ± : 35″ ± : 7 . . . 16; "large star red." The principal star is not red — yellowish at most.

Weisse

R.A. = 0h 45m 56s
Decl. = + 25 8′

"Duplex" in Weisse. Not double except as a wide pair in the finder. There are three observations in Weisse differing slightly in place.

O.Arg.N.901. 8.5 . . . 8.9

R.A. = 0h 50m 3s
Decl. = + 59° 41′

1901.796	201°9	20″82
.799	202.8	20.64
1901.79	202.3	20.73

"Duplex" in O.Arg. The only measures are 203°2 : 21″24 (1892.77) Espin. The components are D.M. (59°)150 and 149.

μ *Andromedae.* 4 . . . 13.5 . . . 13.2

R.A. = 0h 50m 6s
Decl. = + 37° 51′

A and C (= H 1057)

1901.799	122°2	36″87
.818	122.3	36.87
1901.80	122.2	36.87

A and B

1901.818	310°8	39″82
.835	311.4	39.56
1901.82	311.1	39.69

The large star has a proper motion of 0″173 in 73°2.

1878.67	110°9	38″37	3*n*	*β*
1878.67	314.4	37.27	3*n*	*β*

Winnecke. D.M.(8°)137. 9 . . . 9.2

R.A. = 0h 51m 46s
Decl. = + 8° 38′

1901.703	128°.3	5″.40
.760	130.1	5.41
1901.73	129.2	5.40

The only other measures are:

1863.86	130°.2	5″.32	2*n*	Wn

H 2026. D.M.(4°)204. 8.6 . . . 11

R.A. = 1h 5m 42s
Decl. = + 4° 15′

1900.706	306°.6	10″.11
.742	306.0	10.34
.782	305.6	10.33
1900.74	306.1	10.26

H gives 303°.3 : 10″± : 10 . . . 15 (1830). The principal star has a considerable proper motion, 0″.214 in 215°.1 (Porter) and 0″.28 in 230°.8 (Boss). This would seem to be common to both stars.

Σ 103. S.D.(2°)192. 8.4 . . 9.7

R.A. = 1h 10m 33s
Decl. = − 2° 10′

1901.703	246°.5	5″.49
.796	246.7	5.34
1901.75	246.6	5.41

No recent measures, but probably unchanged. Some uncertainty in place heretofore.

H 5453. D.M.(—1°)167. 8.3 . . . 9.9

R.A. = 1h 12m 29s
Decl. = − 1° 29′

1901.703	208°.3	27″.56
.796	208.5	27.35
1901.75	208.4	27.45

The positions are estimated by H, 210° : 30″. Engelhardt gives 209°.5 : 27″.95 (1891.81) 2*n*. The principal star has a proper motion of 0″.499 in 121°.4, and the small star seems to be moving with it.

Barnard. D.M.(3°)184. 8.5 . . . 11

R.A. = 1h 12m 40s
Decl. = + 4° 1′

1900.742	12°.0	1″.45

Discovered by Barnard. No change since his measures of 1894.

H 1079. 44 *Ceti.* 6 . . . 10.5

R.A. = 1h 18m 0s
Decl. = − 8° 38′

1900.725	298°.9	80″.37
.744	298.5	80.37
1900.73	298.7	80.37

The only observations are:

300°.5	60″ ±	1828	1*n*	H
299.6	76.40	1877.86	1*n*	β

The principal star has a proper motion of 0″.134 in 115°.4, which accounts for the change in distance.

H 638. 11.2 . . . 11.5

R.A. = 1h 19m 5s
Decl. = − 4° 47′

1901.760	271°.8	9″.52
.876	271.3	9.30
1901.82	271.5	9.41

In the field *nf* S.D.(4°)203. The only observation is by H, 273°.0 : 2″–3″ (1820).

H 640. S.D.(4°)230. 9.5 . . . 9.5

R.A. = 1h 27m 27s
Decl. = − 4° 8′

1901.760	290°.1	5″.33
.876	291.3	5.29
1901.81	290.7	5.31

No other measures.

τ *Andromedae.* 5 . . . 10.2

R.A. = 1h 33m 30s
Decl. = + 39° 58′

1900.684	329°.0	52″.53
.706	329.1	52.73
1900.69	329.0	52.63

The only other observations are 328°.4 : 52″.35 (1880.68) 2*n* β. The proper motion of this star is small, 0″.019 in 37°.4.

H 2067. L 3056. 7.2 . . . 11.1.

R.A. = 1h 33m 33s
Decl. = − 18° 24′

1901.760	91°.3	34″.07
.876	91.9	33.66
1901.81	91.6	33.86

Probably without change. The distance in H of 5″ may be a misprint for 25″. In my measure of 1878 the distance is printed 23″.90 instead of 33″.90. The measures of Wilson (Cin[10]) belong to H 3455, which is 4m *f* this pair.

H 1088. L 3044. 7.0 . . . 9.5

R.A. = 1h 31m 20s
Decl. = + 58° 1′

1900.780	168°.0	19″.52
1901.796	167.2	19.41
1901.79	167.6	19.46

H gives 164°.5 : 15″ ± (1828).

H 3455. 9.1 . . . 9.2

R.A. = 1h 37m 31s
Decl. = − 18° 13′

1901.760	74°.5	23″.56
.876	73.6	23.73
1901.81	74.0	23.64

The components are S.D.(18°)291 and 292. The only measures are:

1882.70	73°.2	23″.90	1*n*	Wilson

Σ 168. 8.5 . . . 10

R.A. = 1h 43m 6s
Decl. = + 66° 9′

1900.725	224°.2	1″.73
1901.796	222.6	1.87
1901.76	223.4	1.80

No measures since ⅃ in 1867. No evidence of change. H could not see it, and I failed with the 6-inch 1874.

Hd 54. D.M.(1°)335. 8.6 . . . 11.2 . . . 11.2

R.A. = 1h 44m 26s
Decl. = + 1° 55′

A and B

1900.706	117°.1	4″.48
.742	116.7	4.18
1900.72	116.9	4.33

A and C

1900.706	211°.8	15″.67
.742	211.1	15.42
1900.72	211.4	15.54

The only other measures are by the Harvard observers on one night in 1867. They give for AC, 213°.1 : 14″.26 (1867.96).

Σ 188 *rej.* 8.8 . . . 9.4

R.A. = 1h 50m 47s
Decl. = + 62° 20′

1901.722	238°.4	32″.54
.796	238.4	32.62
1901.76	238.4	32.58

H describes the components "very red: fine green." The colors are less prominent.

H 1100. B.A.C. 588. 6.3 . . . 10.6

R.A. = 1h 50m 47s
Decl. = + 64° 3′

1901.722	310°.4	38″.81
.796	310.1	38.83
1901.76	310.2	38.82

H gives 310°.1 : 30 ±. His declination is 20′ in error.

H 3476. L 3731. 6.2 . . . 9.8

R.A. = 1h 54m 29s
Decl. = − 9° 6′

1900.706	193°.0	62″.05
.725	193.6	61.08
.742	192.5	61.77
1900.72	193.0	61.63

H gives 183°.7 : 60″ ±. His declination is 1° *s* of the real place. The principal star is 5.8m in S.D.

H 647. D.M.(6°)319. 8.8 . . . 9.3

R.A. = 1h 56m 16s
Decl. = + 7° 6′

1900.706	35°.6	26″.71
.742	34.3	26.43
.782	35.1	26.60
1900.74	35.0	26.58

Positions estimated by H; "large star deep blood red — a very intense and remarkable color; small star green." The colors are very marked.

Σ 207. D.M.(16°)233. 9 . . . 10

R.A. = 1h 56m 45s
Decl. = + 17° 1′

1901.873	186°.7	11″.88
.876	185.0	11.96
1901.87	185.8	11.92

No recent measures, but without change.

H 2104. D.M.(52°)500, 501. 8.7 . . . 8.8

R.A. = $1^h 57^m 9^s$
Decl. = + 52° 27′

1901.722	167°.2	30″.27
.758	347.0	30.12
1901.74	167.1	30.19

Both R.A. and Decl. erroneous in H. He gives 166°.4 : 25″±. Identified as above.

H V. 102. 61 *Ceti.* 6 . . . 9

R.A. = $1^h 57^m 39^s$
Decl. = − 0° 55′

1900.706	193°.7	43″.07
.725	194.2	43.11
1900.71	194.0	43.09

H in 1873 made two measures of the distance, 34″.50 and 37″.88. The only other measures are my own, 193°.3 : 42″.71 (1877.86). Bossert gives the proper motion 0″.144 in 123°.7.

Σ 211 *rej.*

R.A. = $1^h 58^m$ ±
Decl. = − 6° 0′

H could not find any pair in or near this place. Σ gave this as Class IV, 8 . . . 11. There is no star in the assumed place. There is a 7½m star about 15′s with a distant 9½m star in the field, which may be the one in question.

Σ 213. D.M.(50°)459. 8.4 . . . 8.6 . . . 12.5

R.A. = $2^h 1^m 17^s$
Decl. = + 50 30′

A and B

1900.782	320°.6	1″.96
1901.722	323.6	1.81
1901.25	321.8	1.88

A and C

1900.782	62°.8	7″.19
1901.722	59.7	6.88
1901.25	61.2	7.03

No recent measures; no sensible change. The third star has not been seen before.

Σ 219. 8.2 . . . 8.7

R.A. = $2^h 3^m 11^s$
Decl. = + 32° 48′

1900.742	183°.6	11″.63
1901.586	183.9	11.49
.818	182.3	11.50
1901.38	183.3	11.54

No recent measures; apparently fixed.

Σ 226. 8.4 . . . 10.2

R.A. = $2^h 5^m 27^s$
Decl. = + 23° 24′

1900.706	249°.5	2″.40
.742	246.2	2.13
1901.818	241.8	2.13
.835	244.8	1.95
1901.27	245.6	2.15

No measures since ⅃; little if any change. The Berlin A.G. gives the proper motion of A, 0″.187 in 126°.0, and the small star is therefore moving with it.

H 1115. 10 *Trianguli.* 6 . . . 12

R.A. = $2^h 11^m 59^s$
Decl. = + 28° 5′

1900.742	206°.2	57″.14
.744	204.5	57.04
1900.74	205.3	57.09

H gives 206°.8 : 50±″, and calls the small star 18m. No other measures.

Σ 247 *rej.* D.M.(3°)320. 9.0 . . . 9.0

R.A. = $2^h 12^m 7^s$
Decl. = + 3 37′

1901.703	211°.3	7″.61
.876	212.1	7.48
1901.79	211.7	7.54

The only measure is:

1879.66	32°.2	7″.39	1*n*	Cin

H 2134

R.A. = $2^h 16^m 0^s$
Decl. = − 11° 10′

Described by H, 265°.2 : 9″± : 9 . . . 10.11. There is no pair of this description in or near this place. It is certainly identical with H 2140, which is about 5m*f*.

H 649. 12.5 . . . 13

R.A. = 2h 17m 4s
Decl. = + 9° 4′

1901.799	127°.5	9″.10

H has 120° ± : $1\frac{1}{2}''$ ± : 15 . . . 16.

H 2140. S.D.(11°)459. 8.5 . . . 10

R.A. = 2h 19m 59s
Decl. = − 11° 10′

1901.703	263°.4	10″.70
.742	263.1	10.51
1901.72	263.2	10.60

In H, "R.A. conjectural." Identified as above. Identical with H 2131, for which H gives 265°.2 : 9″ ± : 9 . . . 10-11. The R.A. of that star is also in error.

OΣ (*App*) **27.** 7.5 . . . 8.5

R.A. = 2h 29m 19s
Decl. = + 10° 2′

1900.706	31°.8	73″.67
.725	31.9	73.79
1900.71	31.8	73.73

The only other measures are by ♃, 31°.2 : 73″.96 (1875.42).

Hd Zones

R.A. = 2h 29m 0s
Decl. = + 0° 37′

In the Harvard Zones an 8m star noted as "double." The place is that of the 9m star D.M.(0°) 431, but this is not a double of any kind. Σ 274 is 4m *p*, and possibly the note has reference to that pair.

O.Arg.N. 2946

R.A. = 2h 29m 29s
Decl. = + 49° 44′

"Duplex" in O.Arg. Not double; there is a 10m star about 53″ distant. I failed to find it in 1875.

H 3518. O.Arg.S. 1715. 8.6 . . . 10.5 . . . 10.6

R.A. = 2h 33m 38s
Decl. = − 28° 41′

A and B

1900.742	15°.2	13″.29
1901.760	15.5	13.87
1901.25	15.3	13.58

A and C

1900.742	242°.8	14″.26
1901.760	243.4	14.12
1901.25	243.1	14.19

H gives 19°.6 : 10″ ± and 299° ± : 12″ ±.

O.Arg.N. 3145. 8.4 . . . 8.4

R.A. = 2h 38m 46s
Decl. = + 49° 37′

1901.589	143°.0	3″.08
.758	146.5	3.08
1901.67	144.7	3.08

"Duplex" in O.Arg.N. It is Hussey 204. He gives 143.4 : 3″.17 (1900.87) 3*n*. No other measures. There is a closer pair a little following which I noted many years ago, and in this connection measured it; 155°.5 : 1″.42 (1901.67) 2*n*. This is Hussey 205. It is 57s *f* the other pair, and 3′ *s*.

τ *Persei*

R.A. = 2h 45m 45s
Decl. = + 52° 16′

A and B

1900.684	106°.3	50″.50
.687	106.7	51.30
.725	107.2	51.09
.742	106.3	50.52
1900.71	106.6	50.85

B and C

1900.742	81°.7	4″.58

The faint star B 12m was first noted by Edgecomb, and in measuring that with the $18\frac{1}{2}$-inch the 13m star C was added. My measures of AB are 106°.4 : 50″.67 (1878.46) 2*n*. There is a 14m star from A 337°.3 : 42″.46 (1900.74) 1*n*.

Σ 324 *rej.* D.M.(46°)658. 6.7 . . . 12.2

R.A. = 2h 48m 27s
Decl. = + 46° 41′

1900.687	203°.4	24″.94
.725	203.2	25.10
.782	203.5	24.81
1900.73	203.4	24.95

H gives 191°.4 : 12″ ± for AB, and 312°.4 : 8″ ± for AC. I could see only the star measured, which is B of H. This was rejected by Σ as a close pair.

H 3543. Cord.D.M.(29°)1096. 10 . . . 10.3 . . . 12

R.A. = 2h 52m 30s
Decl. = − 29° 28′

A and B

1901.876	264°2	9″89

A and C

1901.876	69°5	14″39

No measures; described in H, "Triple; Cl. I and II."

Σ 334

R.A. = 2h 53m 1s
Decl. = + 6° 10′

1900.666	316°2	1″45
.668	317.6	1.36
1900.67	316.9	1.40

H 2170. γ *Persei.* — . . . 11.2

R.A. = 2h 56m 6s
Decl. = + 53° 2′

1900.684	324°7	57″56
.725	325.0	57.43
.782	324.9	57.32
1900.73	324.9	57.44

H gave the angle 224°9, probably an error of 100°. The only measures are 323°7 : 57″72 (1879.55) 2*n* β.

O.Arg.N. 3418. 9.0 . . . 9.0

R.A. = 2h 57m 34s
Decl. = + 52° 35′

1901.835	90°1	4″09
.854	90.0	4.19
1901.84	90.1	4.14

"Duplex" in O.Arg. The only measures are:

1900.06	90°2	4″50	2*n*	Espin

Σ 353 *rej.* D.M.(17°)494. 9.6 . . . 11.0

R.A. = 3h 0m 47s
Decl. = + 17° 25′

1901.720	59°2	10″70
.799	58.0	10.63
1901.76	58.6	10.66

No other observations except angle of 56°4 by H.

H V. 117 = Σ 359 *rej.* 7.5 . . . 8.5

R.A. = 3h 4m 17s
Decl. = + 21° 58′

1900.725	320°5	33″39
.744	320.2	32.59
1900.73	320.3	32.99

The only other measures are by H; 317°5 : 34″80 (1783.65) 1*n*. The principal star is D.M.(21°)418. There is a nearer companion, 13m, 267°0 : 14″69 (1900.72) 1*n*.

H 3557. L 6037. 8 . . . 10.9

R.A. = 3h 9m 12s
Decl. = − 14° 53′

1900.706	2°4	27″13
.742	2.2	26.77
1900.72	2.3	26.95

There is an error of 1° in the Decl. of H. The only observations are:

1835.90	9°9	20″±	1*n*	H
1880.27	5.3	27.13	3*n*	β

Σ 371

R.A. = 3h 10m 23s
Decl. = + 46° 35′

1900.687	81°7	3″56
.782	82.8	3.14
1901.589	81.1	3.51
1900.76	81.9	3.40

From the measures of ⅃ the angle appeared to be increasing.

1831.20	74°7	3″35	3*n*	Σ
1867.45	81.7	3.32	3*n*	⅃

It would now appear that Σ's angle was too small, and that the stars are really fixed.

H 3570. 7 . . . 12

R.A. = 3h 16m 18s
Decl. = − 20° 45′

1900.706	256°1	33″89
.742	256.0	34.21
1900.72	256.0	34.05

No measures in H; described as "triple or quadruple." No nearer companion than that measured, but other small stars in the field more distant.

H 2187. S.D.(11°)652. 8 . . . 10.7

R.A. = 3h 17m 32s
Decl. = −11° 47′

1901.703	240°.7	56″.04
.742	240.2	56.00
1901.72	240.4	56.02

In one observation H gives for the angle 239°.5 (1830), and later 325°.3 (1835.9). There is probably an error of 90° in the last. This pair appears to be Σ 387 *rej.* Hussey 20 is about 1m 40s *p*, which was measured once, 235°.4 : 0″.24 (1901.74).

Nova Persei

R.A. = 3h 23m 8s
Decl. = +43° 30′

Two of the small stars in the field were measured, and then the work discontinued, as it appeared that Aitkin had carefully measured them all.

1901.167	63°.4	158″.14
.529	63.0	158.11
1901.35	63.2	158.12
1901.167	116°.7	102″.38
.529	116.4	101.95
1901.35	116.5	102.16

H IV. 89. L 6436. 8.1 . . . 9.5

R.A. = 3h 23m 35s
Decl. = +19° 41′

1901.712	117°.1	20″.35
.796	116.9	20.27
1901.77	117.0	20.31

Porter gives the proper motion of A, 0″.203 in 108°.0. The components seem to be moving together.

1783.73	152°.0	20″.05	1*n*	H
1879.66	117.3	20.10	1*n*	Cin

Σ 417 *rej.* S.D.(3°)572. 8.5 . . . 9.6

R.A. = 3h 27m 27s
Decl. = −2° 57′

1901.703	179°.5	25″.78
.742	179.8	25.78
1901.72	179.6	25.78

The only other position is 178°.3 : 25″ ± (1830) H.

Σ 416 *rej.* D.M.(19°)556. 8.8 . . . 9.7

R.A. = 3h 28m 2s
Decl. = +19° 24′

1901.720	56°.6	26″.54
.742	56.5	26.30
1901.73	56.5	26.42

The principal star is catalogued as red. There is a 11.5m star, 292°.9 : 22″.61, previously noted by Espin.

Σ 457. D.M.(22°)576

R.A. = 3h 43m 15s
Decl. = +22° 19′

A and B

1901.815	99°.5	1″.14
.818	102.0	1.19
1901.81	100.7	1.16

A and C = 12.6m

1901.815	340°.5	18″.15
.818	337.1	18.24
1901.81	338.8	18.20

This was observed for the distant star which has not been measured before. Σ mentions it as 347° : 32″. There is no change in the close pair.

H 666. L 7069. 6.5 . . . 12.7

R.A. = 3h 43m 15s
Decl. = +9° 3′

1900.684	19°.2	30″.72
.687	18.3	30.85
1900.68	18.7	30.78

No other measures. H gives 25° ± : 25″ ± 6 . . . 17–18.

H 667. 10.5 . . . 12.7

R.A. = 3h 44m 15s
Decl. = −0° 33′

1901.703	89°.7	12″.64
.758	91.1	12.38
1901.73	90.4	12.52

H gives 90° ± : 4″–5″ AB, and 300° ± : 15″ AC, with magnitudes 9, 12, and 18. I did not see the third star. Not in S.D.

H 668. D.M.(−0°)608. 8.5 . . . 10.5

R.A. = $3^h 44^m 44^s$
Decl. = − 0° 32′

1901.703	299°.0	21″.67
.758	298.1	21.23
1901.73	298.5	21.50

Only H, 315°± : 18″± : 8 . . . 12.

H 3601. Cord.D.M.(23°)1600. 7.2 . . . 9.5

R.A. = $3^h 46^m 31^s$
Decl. = − 23° 18′

1901.760	300°.4	10″.62
.796	299.6	10.54
1901.78	300.0	10.58

H found 303°.5 : 15″± : 8½ . . . 10. No. 33 of the Lowell Catalogue could not be found by Cogshall. It is evidently identical with H 3601, See having an error of 1° in his Decl. His measures were 299°.2 : 10″.73 : 7 . . . 10.8 (1897.72).

Σ 462. 9.6 . . . 10

R.A. = $3^h 46^m 42^s$
Decl. = + 52° 1′

1901.720	317°.7	8″.20
.742	320.7	8.03
1901.73	319.2	8.11

No recent measures, but unchanged. Not in D.M., but near D.M.(51°)804.

43 *Persei.* S 440 = H V. 41

R.A. = $3^h 47^m 41^s$
Decl. = + 50° 21′

1901.720	30°.4	75″.47
.742	29.9	75.27
.758	30.1	75.36
1901.74	30.1	75.37

The principal star has a proper motion of 0″.155 in 147°.6, which also belongs to the 9.5 companion.

1863.07	29°.7	75″.15	4*n*	OΣ
1888.19	30.0	75.34	2*n*	Engelhardt

There is a 12.5m star nearer than this in 279°.

OΣ (*App*) **41.** 7 . . . 8.5

R.A. = $3^h 48^m 6^s$
Decl. = + 4° 49′

1900.684	357°.0	58″.72
.687	357.3	59.37
1901.854	357.2	58.96
1901.07	357.2	59.02

The only measures are by ⅃ in 1875. There is no change.

H 3608. γ *Eridani.* 3½ . . . 13.2

R.A. = $3^h 52^m 24^s$
Decl. = − 13° 51′

1900.706	241°.7	52″.68
.742	241.5	52.80
1900.72	241.6	52.74

The only other complete measures are my own, 238°.4 : 51″.93 (1877.88) 2*n*. The change in angle is due to the proper motion of A, 0″.114 in 158°.3.

H N. 93

R.A. = $3^h 57^m$±
Decl. = + 23° 6′±

No measures in H; given as Class II; "place extremely precarious." The place agrees with D.M. (22°)626, but that is not double, and has no faint star near it. The pair in question is probably identical with Σ 479.

H 2220. D.M.(56°)885. 8 . . . 11.5

R.A. = $3^h 59^m 49^s$
Decl. = + 56° 7′

1900.744	296°.6	25″.63
.763	296.5	25.97
1900.75	296.5	25.80

H gives 296°.4 : 14″± : 9 . . . 11 (1830).

Σ 492 *rej.* 6.6 . . . 10 . . . 10

R.A. = $4^h 0^m 6^s$
Decl. = + 41° 10′

A and B

1900.687	202°.5	94″.47
.744	202.2	94.31
1900.71	202.3	94.39

B and C

1900.687	135°.7	5″.47
.744	135.7	5.74
1900.71	135.7	5.60

In Σ Classes I and VI. No other measures.

Hd 66. S.D.(16°)783. 9.6 . . . 9.6

R.A. = 4h 1m 32s
Decl. = − 16° 10′

1901.760	83°8	17″73
.796	83.1	17.75
1901.78	83.4	17.74

Given in the Harvard Annals with rough place, and 261°7 : 18″52 : 9.3 . . . 9.5 (1868.48) 3*n*. There is a 15m star nearer A, 263°4 : 5″68 (1901.79) 1*n*.

OΣ 73. μ *Persei*

R.A. = 4h 6m 5s
Decl. = + 48° 6′

A and B

1901.720	349°8	14″52
.722	348.5	14.24
1901.72	349.1	14.38

A and C (= H VI 20 = Sh 364)

1901.720	231°9	84″02
.722	231.6	84.30
1901.72	231.7	84.16

No change in B. For AC Sh found 231°7 : 91″56 (1822.85) 2*n*. There is a 12.8m star nearer than C, 121°2 : 50″36 (1901.72) 1*n*.

H 673. D.M.(30°)641. 9.2 . . . 9.6

R.A. = 4h 9m 25s
Decl. = + 30° 30′

1901.799	195°5	21″40
.818	195.8	21.09
1901.81	195.6	21.19

H gives 210° ± : 18″ ± : 7 . . . 10. I found many years ago that there was an error in H's magnitude of A. This is given as 9.2 in D.M.

Σ 519 *rej.* D.M.(50°)976. 7.7 . . . 9.3

R.A. = 4h 11m 52s
Decl. = + 50° 5′

1900.744	316°4	18″29
.763	315.8	17.98
1900.75	316.1	18.13

Given as Class IV in Σ. The only other measures are by Espin, 316°8 : 18″50 (1892.96) 2*n*.

OΣ (App) 49. 7.5 . . . 7.5

R.A. = 4h 12m 41s
Decl. = + 1° 29′

1901.742	144°6	102″80
.758	144.8	102.79
1901.75	144.7	102.79

Fixed; ⅃ gives 144°9 : 102″94 (1875.33) 3*n*. No other measures. These stars are Lalande 8090 and 8093.

Σ 537. 8.5 . . . 9.7

R.A. = 4h 16m 21s
Decl. = − 10° 14′

1900.706	341°5	16″36
.742	341.6	16.49
1900.72	341.5	16.42

Distance and angle slowly increasing.

1832.39	334°0	14″99	4*n*	Σ
1867.10	336.9	15.28	3*n*	⅃
1891.86	340.1	15.98	1*n*	β

β 402

R.A. = 4h 17m 3s
Decl. = − 1° 33′

1901.760	75°3	7″53
.796	73.7	7.52
1901.78	74.5	7.52

This was put on the list in order to observe a third faint star noted by Cogshall at 110 : 7″8, referred to in my General Catalogue. I found a 14m star 111°1 : 29″0. Since then I have learned from him that there was an error in transcribing the distance, which was really 29″, as I found it.

Σ 530. D.M.(53°)769

R.A. = 4h 17m 5s
Decl. = + 53° 13′

A and B

1901.720	200°5	14″12
.722	200.7	14.19
.742	199.2	14.06
1901.73	200.1	14.12

A and C

1901.742	279°6	36″81
.758	280.3	36.83
1901.75	279.9	36.82

C and D (new). 11.8 . . . 12.0

1901.742	43°2	1″39
.758	44.4	1.55
1901.75	43.8	1.47

No other measures of C, but it was noted by H in his Fifth Catalogue. This star I found to be a rather difficult pair. The only measures of AB since Σ are by Ma and ⅃. There is no change.

H 342 = H IV. 117 = Σ 539 *rej.* 8.2 . . . 10.2 . . . 12.5

R.A. = 4h 17m 19s
Decl. = − 5° 17′

A and B

1901.706	234°8	17″69
.742	235.2	17.35
1901.72	235.0	17.52

A and C

1901.706	82°5	28″27
.742	81.8	28.18
1901.72	82.1	28.22

H gave 238°2 : 19″53 (1783.13) 1*n*. No other measures since, except my own in 1877, which show no change as compared with the above.

Σ 541 *rej.* 9.2 . . . 9.3

R.A. = 4h 18m 14s
Decl. = + 21° 58′

1900.725	331°8	5″22
.744	328.3	5.83
.780	329.5	5.37
1900.75	329.9	5.47

This is the faint pair between κ^1 and κ^2 *Tauri.* The only other measures are by ⅃, 327°2 : 4″94 (1874.11) 4*n*.

Σ 547. 8.5 . . . 10.4

R.A. = 4h 19m 48s
Decl. = − 1° 40′

1901.758	43°9	2″04
.796	44.5	1.98
1901.78	44.2	2.01

The change in angle is about 60° since 1831. A comparison of these measures with Σ's gives 0″052 in the direction of 316°1 for the proper motion of A.

57 *Persei.* Sh 44 = H VI. 99

R.A. = 4h 24m 58s
Decl. = + 42° 48′

1900.687	198°8	115″38
.744	198.4	114.83
.763	198.6	115.46
1900.73	198.6	115.22

The change is due to proper motion, probably of the smaller star. This is given in the A.G. as 0″076 in 157°7.

1821.91	198°9	110″19	1*n*	Sh
1875.11	198.9	113.68	2*n*	⅃

This change in distance corresponds to the movement as given of B.

H 3653. O.Arg.S. 3129 and 3130. 8.3 . . . 8.5

R.A. = 4h 25m 7s
Decl. = − 16° 43′

1900.742	156°3	42″58
1901.758	157.4	42.42
1901.75	156.8	42.50

The only other measures are 148°5 : 40″± (1835.9) H. The O.Arg. places give 155°9 : 48″87 (1850±).

Hd Zones. 10.7 . . . 12

R.A. = 4h 26m 11s
Decl. = + 1° 2′

1900.742	235°8	1″93
1901.796	239.2	2.42
1901.77	237.5	2.17

Marked "elongated" in the Harvard Zones. No other observations.

S 451 = OΣ (*App*) 51. 7.3 . . . 7.7

R.A. = 4h 27m 25s
Decl. = + 47° 7′

1900.687	198°4	58″68
.744	198.1	58.62
1900.71	198.2	58.65

Probably unchanged.

1875.13	197°4	59″27	2*n*	⅃
1875.3	198.4	59.44		A.G.

H 344. D.M.(33°)883. 8.4 . . . 11

R.A. = 4h 28m 26s
Decl. = + 33° 41′

1900.744	102°0	11″20
.780	102.4	11.14
1900.76	102.2	11.17

The only observations are by H, 95°± : 10″± : 10 . . 14. There is a 14m star 82.2 : 17″5.

Σ 565

R.A. = 4h 29m 42s
Decl. = + 41° 53′

1900.780	174°3	1″63
.782	173.3	1.48
1900.78	173.8	1.55

Probably fixed. Measured in looking for the Weisse pair given below.

β 1043. 3 *Camelopardali*

R.A. = 4h 30m 28s
Decl. = + 52° 50′

1900.687	299°1	3″66
.780	295.8	3.73
.782	292.6	3.74
1901.796	294.3	3.55
.815	297.2	3.88
.818	295.2	3.83
1901.28	295.7	3.73

Weisse IV. 647. 9 . . . 9.1

R.A. = 4h 31m 42s
Decl. = + 42° 6′

1901.720	110°3	2″46
.722	113.8	2.44
1901.72	112.0	2.45

Weisse IV 643 is noted "duplex 3″" in that catalogue. That star is not double, and the note doubtless belongs to the one given here, which is about 5°s. No other measures.

H 346 B.A.C 1444. 6.1 . . . 11.0

R.A. = 4h 33m 49s
Decl. = + 28° 23′

1901.742	54°5	43″37
.758	54.7	43.27
1901.75	54.6	43.32

No other measures; only estimates by H.

Σ 579. 8.6 . . . 9.7

R.A. = 4h 34m 32s
Decl. = + 22° 30′

1901.758	34°5	16″31
.799	34.7	16.43
1901.78	34.6	16.37

No recent measures. No material change.

S 455. τ *Tauri*

R.A. = 4h 35m 2s
Decl. = + 22° 44′

1900.684	213°2	63″02
.687	213.1	62.94
1900.68	213.1	62.98

Without change. Δ gives 212°4 : 62″85 (1875.35) 2*n*. Large star supposed to be a close pair from an occultation observed by Hough (A.J. 474). Conditions too unfavorable at the time of my measures to detect a very close pair.

Σ 585. D.M.(4°)733. 8.6 . . . 10.5

R.A. = 4h 36m 21s
Decl. = + 4° 29′

1900.706	275°7	11″85
.742	275.9	12.05
1900.72	275.8	11.95

No recent measures, but unchanged. Place heretofore approximate; identified as above. The magnitude of A in D.M. is 9.2; Σ gives 8.3.

Hall. D.M.(1°)809. 9.1 . . . 9.1

R.A. = 4h 37m 53s
Decl. = + 1° 51′

1901.742	157°3	2″35
.758	155.8	2.37
.760	156.1	2.53
1901.75	156.4	2.42

Identified as above. The only other measures are by Hall, 157°4 : 2″29 (1888.10) 3*n*.

D.M.(21°)694. 9.1 . . . 10.5

R.A. = 4h 38m 51s
Decl. = + 24° 3′

1901.758	114°7	5″44
.799	113.8	5.37
1901.78	114.2	5.40

This was measured in trying to find Σ 593 *rej.*, which should be about $1^m f$ and $10° n$. Σ gave Class IV and magnitudes 8.9 . . . 8.9. There is no such star in this place. The 8m star some distance *sf* has a very distant 11m star in 103°, but neither that nor the one measured is likely to be the Σ star.

H 350. 11 . . . 11

R.A. = $4^h 43^m 18^s$
Decl. = + 34° 35′

1901.799	308°.3	5″.32
.818	308.2	4.96
1900.81	308.2	5.14

H describes it as "extremely delicate and beautiful," and gives 310° ± : 2″ ±. It is in the field with D.M.(34°)914.

H VI. 83. D.M.(6°)765. 7 . . . 8.5

R.A. = $4^h 44^m 12^s$
Decl. = + 6° 37′

1900.684	4°.1	96″.08
.742	3.7	95.78
1900.71	3.9	95.93

The only other measure is by H, 1°.7 : 80″.97 (1783.79) 1*n*.

S 457. 8.3 . . . 8.3

R.A. = $4^h 46^m 59^s$
Decl. = − 1° 28′

1900.763	354°.5	41″.03
.780	354.5	41.01
1901.758	354.6	40.96
1901.10	354.5	41.00

No other measures except S, 353°.7 : 41″.49 (1824.42) 3*n*. These stars are D.M.(−1°)744 and 743.

H 3705. O.Arg.S. 3514. 7.7 . . . 10.5

R.A. = $4^h 51^m 24^s$
Decl. = − 16° 19′

1901.758	141°.7	22″.62
.796	140.8	22.14
1901.78	141.2	22.38

The only other measures are:

1835.9	139°.3	16″ ±	1*n*	H
1880.4	141.0	22″.29	3*n*	β

H 689. L 9355. 7.5 . . . 11.3

R.A. = $4^h 52^m 8^s$
Decl. = − 2° 24′

1901.758	277°.6	20″.76
.760	279.3	21.18
1901.76	278.4	20.97

The only other measures are 275°.6 : 20″.67 (1880.63) 2*n* β.

W[1] IV. 1215. 9 . . . 9

R.A. = $4^h 56^m 5^s$
Decl. = + 13° 11′

1900.744	83°.0	4″.38
.763	84.0	4.39
1900.75	83.5	4.38

"Duplex" in Weisse. The only other measures are in Leipsic A.G., p. 207, 82°.2 : 4″.59 (1893.79) 1*n*.

H 2247. S.D.(5°)1135. 8.5 . . . 11.9

R.A. = $4^h 56^m 51^s$
Decl. = − 5° 53′

A and B

1901.758	58°.2	20″.91
.796	55.7	20.67
1901.77	57.0	20.79

A and C

1901.758	18°.7	33″.18
.796	17.1	33.42
1901.77	17.9	33.30

C and D (11.6 . . . 13)

1901.758	313°.5	2″.67
.796	315.2	3.26
1901.77	314.3	2.96

No other measures. H gives 55°.6 for AB. The closer star is new.

OΣ 94 *rej.* O.Arg.N. 5495. 7.5 . . . 11 . . . 11.3

R.A. = $4^h 58^m 7^s$
Decl. = + 50° 8′

A and B

1900.744	304°.3	17″.90
.763	304.0	18.17
1900.75	304.1	18.03

A and C

1900.744	63°7	25″14
.763	62.6	24.95
1900.75	63.1	25.04

There is a 14m star from A, 340°9 : 26″1.

Σ 640. (= H 356)

R.A. = 4h 59m 11s
Decl. = + 33° 15′

A and B

1900.725	96°9	9″52
.763	96.3	9.44
1900.74	96.6	9.48

A and C (C = 11m)

1900.725	315°6	25″26
.763	317.0	25.30
1900.74	316.3	25.28

C not in Σ; first noted by H; not measured before. No recent measures of AB, but without change.

S 466 (= H VI. 105). 105 *Tauri*

R.A. = 5h 0m 45s
Decl. = + 21 33′

1900.725	250°8	111″45
.763	250.3	111.29
1900.74	250.5	111.37

Both stars have meridian positions. No measures except S.

1825.04	251°0	109″99	2*n* S
1825±	251.2	116.33	Weisse
1875±	250.7	110.44	A.G. Berlin

The proper motion of A is very small, 0″025 in 276°8.

Edgcomb. 103 *Tauri.* 6 . . . 13

R.A. = 5h 0m 48s
Decl. = + 24 6′

A and B

1900.725	117°0	13″02
.763	152.3	13.57
1900.74	119.6	13.30

A and C (= H V. 114)

1900.725	198°0	35″52
.763	197.4	35.50
1900.74	197.7	35.51

The faint star B was detected by Edgcomb in 1878. The only measures are 147°9 : 12″94 (1878.98) 1*n* β; and for the other, 197°6 : 30″05 (1783.80) 1*n* by H.

Σ 642 *rej.* 66 *Eridani.* 6 . . . 9.7

R.A. = 5h 0m 48s
Decl. = − 4° 49′

1900.763	9°3	52″85
.780	10.0	52.77
1900.77	9.6	52.81

The only other measures are, my own, 9°4 : 52″50 (1879.95) 2*n*.

S 468 (= Σ 650 *rej.*). 8 . . . 8.1

R.A. = 5h 3m 27s
Decl. = + 13° 51′

1900.744	165°4	26″25
.763	165.8	26.45
1900.75	165.6	26.35

No measures since South, 162°6 : 27″18 (1825.00) 2*n*. The A.G. positions give 164°4 : 26″68.

OΣ 517

R.A. = 5h 7m 18s
Decl. = + 1° 49′

A and B

1900.780	308°9	0″19

AB and C (C = 12.2)

1900.780	137°3	6″88
1901.815	139.2	6.72
1901.30	138.2	6.80

The faint star discovered by Hall. Unchanged.

OΣ 102

R.A. = 5h 7m 18s
Decl. = + 0° 25′

Certainly round, with all powers, with good conditions 1900.78. It has not been seen otherwise in the last thirty years. It is probably not a double star.

W² V. 199 = D.M.(31)913

R.A. = 5h 9m 31s
Decl. = + 31° 8′

Noted as "duplex" in Weisse. It is not a double star of any kind (1901.79). There is a 4″ pair of 12m stars in the field.

λ *Aurigae*. AD = H V. 22

R.A. = 5ʰ 10ᵐ 42ˢ
Decl. = + 39° 59′

A and B (B = 13.5)

1900.780	273°4	28″92
.782	275.4	29.30
1900.78	274.4	29.11

A and C (C = 12.2)

1900.780	224°4	33″57
.782	225.0	34.09
1901.586	225.5	33.83
1901.05	225.0	33.83

A and D (= Σ 3 *App* II)

1900.780	7°2	133″64
.782	7.2	133.38
1900.78	7.2	133.51

The nearest star has not been seen before. C was added by me with the 18½-in. The measures now show that this star is not moving with A; the only measures are 197°6 : 40″47 (1879.28) 2*n* β. The change is due to the proper motion of A, as is that in the old companion D. The large star has a proper motion of 0″838 in 141°9. A comparison of my measures with those of Σ in 1836 gives 0″856 in 140°6.

H V. 88. D.M.(39°)1250. 9 . . . 10

R.A. = 5ʰ 10ᵐ 46ˢ
Decl. = + 40° 0′

1900.782	217°8	32″43
1901.586	217.3	32.46
1901.18	217.5	32.44

Near λ *Aurigae*. No measures since H, 215°9 : 35″25 (1783.49) 1*n*. There are two faint stars between.

W² V. 269. 8.9 . . . 9.0

R.A. = 5ʰ 11ᵐ 43ˢ
Decl. = + 36° 5′

A and B

1900.782	329°8	2″85
1901.722	329.6	2.81
1901.25	329.7	2.83

A and C (C = 13.5)

1900.782	224°0	9″88
1901.722	225.3	10.36
1901.25	224.8	10.12

Noted in Weisse "duplex 3″." No other measures.

H 3272. 8 . . . 11.5 . . . 11.1

R.A. = 5ʰ 11ᵐ 48ˢ
Decl. = + 39° 14′

A and B

1900.782	342°1	19″40
1901.720	342.0	19.48
1901.25	342.0	19.44

A and C

1900.782	295°5	29″26
1901.720	295.0	29.06
1901.25	295.2	29.16

A and D

1900.782	42°4	33″13
1901.605	42.5	33.71
.720	41.9	33.25
1901.40	42.3	33.36

The only measures are mine of 1879, which show no change.

Aitken 53. S.D.(3°)1061. 8.3 . . . 11.2

R.A. = 5ʰ 13ᵐ 6ˢ
Decl. = − 3° 12′

1900.742	48°3	5″13
.763	47.2	5.13
1901.873	46.9	4.96
1901.12	47.5	5.07

This star has a large proper motion, 0″690 in 77°5, and the companion is moving with it.

H 697. B.A.C. 1657. 6.8 . . . 11.7

R.A. = 5ʰ 15ᵐ 24ˢ
Decl. = − 0° 32′

A and B

1900.763	59°8	33″06
1901.838	59.8	33.10
1901.30	59.8	33.08

A and C (C = 11.2)

1900.763	110°8	38″60
1901.838	112.2	38.28
1901.30	111.5	38.44

The only other measures are:

1878.99	59°8	32″40	1*n*	β
1878.99	109.8	36.81	1*n*	β

There is no error in reducing the last distance, but it seems unlikely that the faint star should have any such motion. The proper motion of A is very small, 0″.017 in 339°.4.

Madler. S.D.(7°)1050. 9.2 . . . 9.2

R.A. = 5ʰ 15ᵐ 32ˢ
Decl. = − 7° 0′

1901.760	159°.3	3″.09
.796	159.5	3.13
1901.78	159.4	3.11

The only other measures since Ma in 1843 are mine of 1877. There appears to be no change.

H V. 68. L 10165. 7.7 . . . 8.5

R.A. = 5ʰ 19ᵐ 0ˢ
Decl. = − 2° 57′

1901.854	281°.8	135″.61
.873	281.8	136.31
1901.86	281.8	135.96

Except an angle in Cin[6], the only measures are:

1783.76 277°.9 120″.18 1n H

S 483. L 10164. 7.4 . . . 8.5

R.A. = 5ʰ 20ᵐ 9ˢ
Decl. = + 33° 41′

1900.744	51°.2	95″.18
.763	50.9	95.32
1901.815	50.9	95.46
1901.11	51.0	95.32

South made the distance 87″.6 in 1825. The only other measures since are Engelhardt in 1891. The change seems to correspond to the proper motion of A, 0″.171 in 180°.0.

Σ 713. D.M.(6°)928

R.A. = 5ʰ 20ᵐ 45ˢ
Decl. = + 6° 52′

1901.838	30°.4	2″.88
.873	30.9	3.23
1901.85	30.6	3.05

No measures since Σ, but without change. It was observed more particularly, to identify the star, and get the correct place.

S 484. D.M.(33°)1064. 8.4 . . . 8.4

R.A. = 5ʰ 21ᵐ 46ˢ
Decl. = + 33° 21′

1900.744	169°.9	58″.90
.763	170.0	59.08
1901.815	170.2	59.03
1901.11	170.0	59.00

No measures since South:

1825.12 170°.0 58″.95 2n

H 701. D.M.(31°)992. 7.2 . . 10.9

R.A. = 5ʰ 22ᵐ 50ˢ
Decl. = + 31° 25′

1901.796	137°.3	35″.40
.799	136.8	35.13
1901.79	137.0	35.26

H has no estimates of angle and distance; "large star very red," and magnitudes 9 . . . 15. It is 7.1m in D.M. Other distant companions; only reddish. This is in his place.

Webb. S.D.(4°)1146 and 1145

R.A. = 5ʰ 23ᵐ 5ˢ
Decl. = − 4° 47′

1901.796	228°.2	46″.94
.815	229.0	46.81
1901.80	228.6	46.87

A is variable, discovered by Webb in 1874. The only other measures are 227°.4 : 46″.70 (1879.14) 2n β.

H V. 101. 7 . . . 10

R.A. = 5ʰ 23ᵐ 37ˢ
Decl. = − 7° 21′

1900.763	116°.6	47″.90
1901.815	117.6	48.42
.838	117.2	48.47
1901.41	117.1	48.26

The only measures are by H in 1783, 105° ± : 44″.25.

Hd 69. S.D.(22°)1125. 9 . . . 12.2

R.A. = 5ʰ 23ᵐ 57ˢ
Decl. = − 22° 43′

1901.815	44°.6	12″.56
2.145	42.9	12.90
1901.98	43.7	12.73

No measures at Harvard. Identified, and corrected place given here. Hd 71, which is given as $2^m f$ and $2's$, is the same pair measured above.

Sh 61. D.M.(2°)986. 8.1 . . . 8.5

R.A. = $5^h 25^m 25^s$
Decl. = + 2° 44′

1901.815	352°5	66″90
.838	353.1	67.27
1901.82	352.8	67.08

The only other measures since 1822 are mine in 1879. There is no change. The A.G. positions give 352°4 : 68″09 (1881).

Engelmann. S.D.(6°)1212 and 1211. 8.6 . . . 8.9

R.A. = $5^h 26^m 28^s$
Decl. = − 6° 29′

1901.838	251°3	44″87
.873	251.2	44.88
1901.85	251.2	44.87

The only measures are by Engelmann, 251°4 : 44″58 (1863.10) 5*n*.

Σ 735. 8.4 . . . 8.7

R.A. = $5^h 27^m 2^s$
Decl. = − 6° 35′

1901.815	352°2	41″64
2.145	351.6	41.50
1901.98	351.9	41.57

The change is due to proper motion.

1831.15	355°2	30″90	2*n*	Σ

These measures give for the proper motion of A, assuming the companion to be fixed, 0″151 in the direction of 162°4.

H V. 118. D.M.(−1°)949. 7.1 . . . 10.7

R.A. = $5^h 27^m 58^s$
Decl. = − 1° 7′

1901.796	263°6	27″58
.815	263.5	27.50
1901.80	263.5	27.54

H has only the angle 256°9 in 1783, and there are no other measures since.

S 490. 8.2 . . . 8.7

R.A. = $5^h 29^m 38^s$
Decl. = − 5° 30′

1900.763	214°5	78″20
.780	214.6	78.05
1900.77	214.5	78.12

The only measures are by South :

1825.21	214°5	77″68	2*n*

W¹ V. 735. 8.5 . . . 9.8

R.A. = $5^h 30^m 39^s$
Decl. = − 13° 54′

1901.838	151°5	44″20
1902.145	151.9	44.32
1901.99	151.7	44.26

Marked "duplex" in Weisse. It is given by Schjellerup in his list of doubles, and estimated 140° : 15″ : 8.5 . . . 9.5. These two stars are S.D.(13°)1192 and 1193, the latter being 1ˢ5*f* and 0′2*n* of the other. There would seem to be no question of considerable change. The meridian positions of A do not indicate any certain proper motion. The movement is probably in the small star.

H 3277. D.M.(17°)972. 8.8 . . . 13

R.A. = $5^h 32^m 23^s$
Decl. = + 17° 41′

1900.744	69°1	23″20
.763	70.5	22.95
1900.75	69.8	23.07

I could not see the companion with the 6-in. in 1876. H gave 73°5 : 20± (1831). It is near Σ 759.

W² V. 1005. 9 . . . 9

R.A. = $5^h 34^m 3^s$
Decl. = + 40° 49′

1901.758	18°4	20″99
.799	17.5	20.97
1901.78	17.9	20.98

"Duplex" in Weisse. No other measures. The components are D.M.(40°)1383 and 1384.

Σ 771. D.M.(19°)1026. 9.0 . . . 9.2

R.A. = $5^h\ 34^m\ 42^s$
Decl. = + 19° 29′

1901.838	55°.2	24″.29
.876	55.3	21.00
1901.85	55.2	24.14

The motion is rectilinear. It was put on the list more particularly for identification. In looking for this, a similar pair 7′ *n* and $4^s f$ was measured:

1901.85	312°.5	29″.25	8.9 . . . 10.4	2*n*

This is D.M.(19°)1027.

29 *Camelop.* H IV. 125 = H 2278

R.A. = $5^h\ 40^m\ 19^s$
Decl. = + 56° 53′

1900.780	130°.7	24″.84
.782	130.8	24.95
1900.78	130.7	24.90

H found 137°.6 : 22″.43 (1783.50) 1*n*. The proper motion is small, 0″.027 in 244°.0.

D.M.(12°)901. 8.4 . . . 13

R.A. = $5^h\ 41^m\ 15^s$
Decl. = + 12° 1′

1900.741	339°.1	9″.19
.763	338.2	10.02
1901.873	340.3	9.15
1901.13	339.2	9.45

Measured in looking for H 5465, which should be about $1^m f$.

β 561. L 10969. 7.4 . . . 13

R.A. = $5^h\ 41^m\ 18^s$
Decl. = + 12° 22′

1900.741	3°.0	19″.17
.763	2.8	18.93
1901.873	3.3	19.02
1901.13	3.0	19.04

Measured in looking for H 5465.

S 500. L 10961 and 10963. 8.5 . . . 8.5

R.A. = $5^h\ 41^m\ 53^s$
Decl. = + 32° 56′

1901.796	89°.3	59″.99
.799	89.2	59.95
1901.79	89.2	59.97

No other measures except S, 88°.9 : 59″.46 (1825.06) 3*n*.

H 5465

R.A. = $5^h\ 42^m\ 5^s$
Decl. = + 11° 57′

The description in H is 45° ± : 12″ ± : 7 . . . (1823): "An excessively minute companion suspected." I looked for it with the 6-in., 1873–74, and with the 18½-in., 1878, without success; and there is no companion visible in the 40-in. on two nights, 1900–1. The place in H is that of the 7.5m star, D.M.(11°)945.

Σ 798. 7 . . . 9.5

R.A. = $5^h\ 42^m\ 25^s$
Decl. = − 8° 25′

1900.763	180°.9	20″.94
.780	181.1	20.87
1900.77	181.0	20.90

No measures since Δ, who suspected a 10^m companion. There is nothing nearer than the Σ star. Unchanged.

56 *Orionis.* 5 . . . 13.5

R.A. = $5^h\ 46^m\ 13^s$
Decl. = + 1° 49′

1901.873	212°.5	43″.45
.876	211.1	43.37
1901.87	211.8	43.41

Taken by mistake for 59 *Orionis.* There are no other measures.

Anderson. L 11231. 7.8 . . . 10.4

R.A. = $5^h\ 49^m\ 18^s$
Decl. = − 19° 44′

1900.780	20°.5	9″.26
1901.873	20.0	9.02
1901.32	20.2	9.14

Given in Hall's observations as discovered by Geo. Anderson with the 26-inch. The place is in error by about 2^m R.A. and 16′ Decl. The only measures are:

1876.09	19°.4	9″.10	2*n*	Hall

H 5466. D.M.(−1°)1075.

R.A. = $5^h\ 51^m\ 38^s$
Decl. = − 1° 50′

Given in H as 8m, with the note: "seen double, but not verified by magnifying." The place is that of the 9.2m star given here. The 40-in. shows a 14m companion, 110°.7, 16″.4 (1901.79).

H V. 100. 59 *Orionis*. . . . 9.7

R.A. = 5h 52m 10s
Decl. = + 1 49′

1900.780	204°3	36″76
1901.876	204.4	36.73
1901.32	204.3	36.74

The proper motion is very small, 0″015 in 136°3. The only measures are:

1783.02	205°±	37″25	1*n*	H
1878.18	205.8	36.57	1*n*	β

Σ 829. 8.9 . . . 10.2 . . . 10.4

R.A. = 5h 54m 0s
Decl. = − 11° 42′

A and B

1900.763	235°5	17″69
.780	235.8	17.93
1900.77	235.6	17.81

B and C

1900.763	220°1	5″60
.780	220.7	5.29
1900.77	220.4	5.44

J could not see the smaller star. Σ found 217°7 : 4″56 (1832.69) 2*n* and 238°4 : 16″50 for AB, which indicate some change.

Σ 861

R.A. = 6h 3m 36s
Decl. = + 30° 42′

A and B

1900.780	17°3	64″92
1901.720	17.1	65.79
.722	16.7	65.60
1901.41	17.0	65.47

B and C

1900.780	138°4	1″65
1901.720	138.1	1.58
1901.25	138.2	1.61

No change in BC, but the distance of A is slowly decreasing. Seabroke thought the principal star was a 0″5 pair. It appears now perfectly round.

H VI. 72. 68 *Orionis*. B = 8.6

R.A. = 6h 4m 55s
Decl. = + 19 49′

1900.744	214°9	85″52
.780	213.7	85.56
1900.76	213.8	85.54

No measures in the last century.

1783.79	229°0	72″83	1*n*	H

The small star appears to be D.M.(19°)1252. The proper motion of A is small, 0″020 in 95°8.

H 2302. 71 *Orionis*

R.A. = 6h 7m 46s
Decl. = + 19 12′

1900.744	203°1	29″20
.780	202.4	29.38
1900.76	202.7	29.29

H estimated the positions. The only measures are by Engelhardt, 202°4 : 31″98(1886.21)2*n*. The change is due to the proper motion of A, 0″203 in 213°3.

H 2315. 11.7 . . . 11.7

R.A. = 6h 15m 6s
Decl. = − 7 14′

1901.796	3°1	6″37
.873	2.1	6.36
1901.83	2.6	6.36

Given by H, 3°0 : 1 ± : 13 = 13 (1830), but the distance may be underestimated. It is S.D.(7°)1384 given as 10m. In looking for this, a very close pair was found about 1m*p* and 2′*n*. This is the 8m star, L 12112.

S 529. W¹ VI. 883. 7 . . . 8 . . . 7.2

R.A. = 6h 30m 51s
Decl. = + 12 17′

A and B

1901.815	153°8	73″85
.838	154.6	74.11
1901.82	154.2	73.98

A and C

1901.815	169°1	167″99
.838	169.2	168.32
1901.82	169.1	168.15

No measures since South in 1825.12; 162°9 : 91″99 and 170°7 : 187″91. This change is explained by the proper motion of A of 0″289 in 194°7. B is a red star.

OΣ 154. L 12831. 6.4 . . . 8.5

R.A. = 6h 35m 52s
Decl. = + 40° 45′

1900.782	123°.6	26″.07
1901.720	123.3	26.15
1901.25	123.4	26.11

Rectilinear motion.

ε *Geminorum*. H VI. 73 = S 533. B = 9.5

R.A. = 6h 36m 33s
Decl. = + 25 15′

1900.782	94°.1	110″.41
1901.818	93.9	110.49
1901.30	94.0	110.45

No measures since South, 93°.7 : 111″.58 (1825.01) 2*n*. The proper motion is very small, 0″.025 in 258°.4, which should give an increasing distance.

Σ 967 *rej*. S.D.(5°)1797. 8.2 . . . 10.5

R.A. = 6h 40m 25s
Decl. = − 6 0′

1900.763	189°.9	13″.22
.780	191.7	13.36
1900.77	190.8	13.29

The only measures are from the introduction to *Mens. Mic.*, 191°.5 : 14″.5 (1832.2) Σ.

H 740. 8.2 . . . 8.7 . . . 11.7

R.A. = 6h 45m 38s
Decl. = + 0° 36′

A and B

1900.763	8°.0	21″.03
1901.167	8.0	20.93
1900.96	8.0	20.98

B and C

1900.763	281°.4	8″.72
1901.167	282.1	8.42
1900.96	281.7	8.57

The only measures are:

1880.59	8°.0	20″.81	4*n*	β
1880.60	283.8	8.18	2*n*	β

H 748. S.D.(8°)1706. 8.4 . . . 10.5 . . . 11.5

R.A. = 6h 57m 12s
Decl. = − 8 10′

A and B

1901.796	170°.6	6″.79
.873	171.9	6.91
1901.83	171.2	6.85

A and C

1901.796	356°.9	15″.29
.873	358.1	15.21
1901.83	357.5	15.25

In Messier 50. H gave the angles 170°.4 and 0°.5 (1820).

OΣ 164 *rej*. L 13675. 7.3 . . . 11.2

R.A. = 6h 58m 20s
Decl. = + 25° 3′

1900.782	50°.6	13″.80
1901.818	49.9	13.51
1901.30	50.2	13.65

At this time there were no published measures in the last fifty years. Madler's distance in 1843 is 9″.09. Hussey's measures in 1899 agree with mine.

Σ 1033

R.A. = 7h 5m 19s
Decl. = + 52° 45′

A and B

1901.799	281°.8	1″.64
.835	274.4	1.82
1901.82	278.1	1.73

A and C

1901.799	271°.9	80″.02
.835	271.4	79.29
1901.82	271.6	79.65

C is not in Σ. No change in AB.

1783.06	266°.3	67″.77	1*n*	H
1880.53	271.7	78.80	2*n*	Ball

OΣ 168 *rej*. L 13937

R.A. = 7h 5m 39s
Decl. = + 21° 33′

A and B

1900.782	66°.3	21″.20
1901.167	67.2	23.78
1900.97	66.7	23.99

A and C

1900.782	114°.3	51″.97
1901.167	114.3	51.70
1900.97	114.3	51.83

At this time no published measures since 1868. From his measures, compared with those of Δ, Hussey finds for the proper motion of A, 0″.047 in 126°.6.

W² VII. 118. 8.2 . . . 8.7

R.A. = 7ʰ 5ᵐ 58ˢ
Decl. = + 15° 23′

1901.167	157°.0	2″.16
.818	157.3	2.27
1901.49	157.1	2.21

In Weisse "duplex 2″." No other measures. The magnitude in D.M. is 7.5.

H 2372. D.M.(20°)1768. 8.1 . . . 12.5

R.A. = 7ʰ 12ᵐ 43ˢ
Decl. = + 20° 41′

1901.818	2°.3	22″.45
.876	3.3	22.34
1901.84	2.8	22.39

No other measures.

S 546. 8.5 . . . 8.6 . . . 8.6

R.A. = 7ʰ 13ᵐ 4ˢ
Decl. = + 31° 42′

A and B

1901.720	358°.8	82″.98
.818	358.6	82.88
1901.77	358.7	82.93

A and C

1901.720	68°.0	143″.94
.818	68.1	144.14
1901.77	68.0	144.04

The only other measures are:

1825.12	359°.4	79″.60	2*n*	S
1825.11	69.2	142.64	1*n*	S

These stars are D.M.(31°)1540, 1541, and 1543. There are faint stars between AB and AC.

D.M.(20°)1775. 6 . . . 13

R.A. = 7ʰ 14ᵐ 52ˢ
Decl. = + 20° 40′

A and B

1900.782	205°.1	17″.62
1901.818	205.1	17.89
1901.08	205.1	17.75

B and C

1900.782	245°.2	7″.73

Taken at first for H 1775. The principal star has a proper motion of 0″.075 in 263°.9.

H V. 66 = S 548. 6.9 . . . 12.2 . . . 8.4

R.A. = 7ʰ 20ᵐ 31ˢ
Decl. = + 22° 23′

A and B

1901.203	19°.6	11″.52
.876	18.6	11.38
1901.54	19.1	11.45

A and C

1901.203	276°.4	35″.32
.876	276.2	35.29
1901.54	276.3	35.30

No material change in the bright stars. The only prior measure of B is by Espin in 1892. C is distinctly greenish.

H V. 63 = Sh 368. 63 *Geminorum*

R.A. = 7ʰ 20ᵐ 37ˢ
Decl. = + 21° 42′

1900.782	323°.2	42″.77
1901.203	323.0	42.91
1900.99	323.1	42.84

The large star has a proper motion of 0″.122 in 214°.1 (Berlin A.G.). H made the distance 44″.25 (1785), and Sh the angle 326°.2 (1826). The only complete measures are:

1863.2	324°.3	44″.61	Radcliffe

γ *Canis Minoris.* . . . 13.0

R.A. = 7ʰ 21ᵐ 38ˢ
Decl. = + 9° 10′

1901.203	240°.2	31″.28
.873	241.5	31.47
.878	243.6	31.22
1901.65	241.8	31.32

The only measures are:

1836.19	247°.3	34″.62	1n	Lamont
1878.06	243.2	32.60	1n	β

The large star has a proper motion of 0″.093 in 286°.9, and the change shown by the measures corresponds to this movement.

S 550. 6.8 . . . 7.1

R.A. = 7h 22m 15s
Decl. = − 18° 15′

1901.167	115°.8	39″.54
.206	116.1	39.55
1901.18	115.9	39.54

The only other measures are by S, 116°.2 : 40″.04 (1825.03) 2n. These stars are L 15159 and 15160, the positions giving 112.9 : 38″.65 (1800).

Σ 1101. 9 . . . 9.1

R.A. = 7h 23m 11s
Decl. = − 13° 34′

1901.167	89°.1	6″.37
.203	88.4	6.47
1901.18	88.7	6.42

The only measures since Σ are by Ma and ⅃. No motion.

Σ 1104. L 14619

R.A. = 7h 23m 55s
Decl. = − 14° 44′

A and B

1900.780	330°.3	2″.40
1901.873	333.5	2.30
1901.132	331.9	2.35

A and C. C = 11.7

1900.780	187°.6	20″.43
1901.203	186.0	20.63
1900.99	186.8	20.53

A and D. D = 11.6

1900.780	5°.8	37″.88
1901.203	5.7	38.29
1900.99	5.7	38.08

The distant stars not in Σ. A has a proper motion of 0″.312 in 216°.4. The change in C and D from the measures of Engelmann in 1882 is due to this motion of A.

H 3973. S.D.(20°)1999. 8.4 . . . 9.3

R.A. = 7h 26m 37s
Decl. = − 20° 40′

1901.873	37°.7	9″.00
1902.222	38.8	8.65
1902.05	38.2	8.82

H gives 36°.3 : 8″ ± (1837.10), and calls the companion "remarkable brick red." It is decidedly reddish. This pair is catalogued as new by See (= λ 81).

Σ 1115. S.D.(12°)2016. 9.5 . . . 9.6

R.A. = 7h 26m 59s
Decl. = − 12° 37′

1901.873	139°.9	12″.35
1902.222	140.1	12.12
1902.05	140.0	12.23

Without change. The companion is S.D.(12°) 2017. (See next pair.)

⅃ 13. S.D.(12°)2019. 9.6 . . . 13.7 . . . 9.7

R.A. = 7h 27m 20s
Decl. = − 12° 34′

A and B (new)

1901.873	208°.8	3″.11
1902.222	209.3	2.70
1902.05	209.0	2.90

A and C (= ⅃ 13)

1901.873	287°.6	11″.87
1902.222	288.9	11.75
1902.05	288.2	11.81

In the field with Σ 1115; the wide stars noted by Dembowski. The large telescope shows a nearer component. The only measures of AC are:

1867.10	288°.4	11″.41	2n	⅃

S 555. L 14888. 7.5 . . . 7.7

R.A. = 7h 31m 10s
Decl. = − 14° 10′

1901.206	228°.3	95″.74
1902.219	228.4	95.77
1901.71	228.3	95.75

Nothing else since South:

1825.00	227°.7	94″.37	2n	S

H 765. L 14890. 8.6 . . . 11 . . . 11

R.A. = 7^h 32^m 30^s
Decl. = + 27° 0′

A and B

1901.720	212°8	23″52
.818	212.3	23.59
1901.77	212.5	23.55

A and C

1901.720	296°7	40″84
.818	296.3	40.55
1901.77	296.5	40.69

No other measures. Distances estimated 15″ and 18″ by H. A has a proper motion of 0″163 in 181°9.

H 2405. 24 *Lyncis*

R.A. = 7^h 32^m 51^s
Decl. = + 58° 59′

1901.799	319°2	54″50
.854	319.8	54.86
1901.82	319.5	54.68

No other measures. H, 319°4 : 60″ ±. The proper motion is small, 0″077 in 217°7.

Procyon

R.A. = 7^h 33^m 1^s
Decl. = + 5° 33′

A and C

1897.884	341°2	57″40

S 560. 6.5 . . . 8.6

R.A. = 7^h 41^m 0^s
Decl. = + 29° 4′

1901.720	358°7	89″50
.818	358.9	89.68
1901.77	358.8	89.59

Without change. The only measures since S are:

1873.21	358°7	89″90	4*n*	OΣ

H III. 28. L 15389. 7.1 . . . 10.7

R.A. = 7^h 46^m 53^s
Decl. = − 13° 33′

1901.203	194°1	23″93
.206	195.5	24.07
1901.20	194.8	24.00

H says, "near 9 *Argus;* place very doubtful," and gives the place of 9 *Argus*. His estimate of the distance is 8″ (1781). This star has a proper motion of 0″101 in 133°8.

OΣ 183 *rej.* 7.5 . . . 12

R.A. = 7^h 47^m 8^s
Decl. = + 16° 21′

1901.815	20°4	15″87
.818	20.1	15.71
1901.81	20.2	15.79

Probably unchanged; 19°8 : 16″19 (1878.12) 3*n* β

S.D.(13°)2277. 7 . . . 12 . . . 12

R.A. = 7^h 47^m 26^s
Decl. = − 13° 45′

A and B

1901.167	161°6	42″39
.203	163.5	41.29
1901.18	162.5	41.84

B and C

1901.203	145°9	4″16

Measured in looking for H III. 28.

D.M.(50°)1495. 8.9 . . . 8.9

R.A. = 7^h 49^m 22^s
Decl. = + 50° 35′

1901.742	103°6	3″24
.799	104.8	3.17
1901.77	104.2	3.20

"Duplex" in Harvard A.G. The only measures are by Espin, 285°2 : 3″14 (1900.12) 2*n*.

D.M.(−1°)1949. 9.5 . . . 9.5

R.A. = 7^h 59^m 47^s
Decl. = − 1° 25′

1902.115	178°6	6″62
.222	178.9	6.89
1902.18	178.7	6.75

Described as "duplex or nebulous" in Nico. A.G. No nebulous appearance with the 40-inch.

W_2 VII. 1609

R.A. = $8^h\ 0^m\ 7^s$ }
Decl. = + 31° 54′ }

Noted "duplex ?" in Weisse. It is not double. There are two distant companions, but too remote to be of any interest (1901.72).

H 3308. D.M.(35°)1767. 7 . . . 10.8

R.A. = $8^h\ 2^m\ 21^s$ }
Decl. = + 35° 49′ }

1901.722	263°.3	45″.81
.742	263.2	45.65
.758	263.4	45.75
1901.71	263.3	45.74

Only H, 231°.6 : 40″ ± (1831). The principal star has a proper motion of 0″.328 in 138.4. In my first measure A was thought to be a close pair, but not verified.

H 2430. D.M.(53°)122. 8.9 . . . 12 . . . 12.5

R.A. = $8^h\ 3^m\ 49^s$ }
Decl. = + 53° 43′ }

A and B

1901.742	311°.2	20″.44
.799	309.4	20.37
1901.77	310.3	20.40

B and C

1901.742	184°.0	8″.20
.799	180.2	8.55
1901.77	182.1	8.37

H gives 311°.5 : 15″ ± and 177° ± : 3 ± and mags. 8, 13, and 11. No other measures. The magnitude in D.M. is 9.2.

OΣ 190 *rej.*

R.A. = $8^h\ 12^m\ 36^s$ }
Decl. = + 17° 48′ }

A and *a* (= Hussey 224)

1901.742	316°.3	4″.09
.854	317.3	4.09
1901.80	316.8	4.09

A and B

1901.742	167°.4	38″.57
.854	167.6	38.43
1901.80	167.5	38.50

A and C

1901.742	280°.4	77″.60
.854	280.5	77.70
1901.80	280.4	77.65

H̥ V. 109. 6 . . . 10.5

R.A. = $8^h\ 19^m\ 27^s$ }
Decl. = + 7° 57′ }

1901.203	312°.6	31″.22
1902.142	342.1	31.70
.145	342.9	31.32
1901.83	312.5	31.41

The only earlier measures are:

1783.14	325°.0	35″.40	1*n*	H̥
1880.61	313.0	31.86	2*n*	β

The large star does not appear to have any sensible proper motion. Probably without change.

A.G.C. 3. ρ *Hydrae.* 5 . . . 12.5

R.A. = $8^h\ 42^m\ 5^s$ }
Decl. = + 6° 17′ }

1901.873	146°.5	12″.05
1902.145	145.5	12.01
1902.01	146.0	12.04

Discovered by Alvan G. Clark with the McCormick 26-inch. Apparently without change.

1878.07	144°.9	12″.40	3*n*	β

H 4146. L 17541. 6.7 . . . 12

R.A. = $8^h\ 46^m\ 48^s$ }
Decl. = − 12° 47′ }

1901.167	103°.2	34″.00
.203	102.9	33.68
1901.18	103.0	33.84

H gives 99°.2 : 35″ ± : 6 . . . 11 (1836). His R.A. is 1^m in error.

S 585. 6 . . . 6.3

R.A. = $8^h\ 49^m\ 4^s$ }
Decl. = − 17° 45′ }

1901.167	146°.9	66″.82
.203	146.9	66.84
1901.18	146.9	66.83

S gives 323°.2 : 69″.36 (1825.22) 3*n*. These stars are L 17636 and 17638.

Schjellerup 11. 9.1 . . . 9.2

R.A. = 9h 1m 36s
Decl. = + 0° 16′

1901.203	259°2	6″46
1902.222	261.3	6.53
1901.72	260.2	6.50

First noted by Schjellerup, and given with estimated position. The principal star is D.M.(0°)2462. There is no evidence of motion. The only other measures are:

1874.26	260°9	6″21	2n	Δ

H VI. 47. 3 *Leonis.* 6 . . . 10.5

R.A. = 9h 22m 6s
Decl. = + 8° 43′

1901.167	80°2	24″90
.299	79.3	24.84
1901.23	79.7	24.87

No measures by H. The later positions do not show any material change. The only other measures are:

1852.19	81°6	25″71	2n	Lassell
1879.48	79.2	25.14	3n	β

τ Hydrae. H VI. 71 = Sh 106 = H 1167

R.A. = 9h 23m 3s
Decl. = − 2° 15′

1901.206	3°7	65″29
.299	3.3	65.31
1901.25	3.5	65.30

The A.G. proper motion of A is 0″118 in 91°9, and B (L 18661) 0″180 in 90°. As they are moving at nearly the same rate, there is little change.

This pair was subsequently observed and catalogued by Sir John Herschel as H 1167, but given with an error of 1° in the declination. There is no doubt of its identity with *τ Hydrae.*

1800	1°4	66″12		Lalande
1821.23	3.2	66.68	1n	Sh
1887.3	3.0	65.32		A.G.

S 604. L 18884. 7.1 . . . 8.7

R.A. = 9h 29m 59s
Decl. = − 19° 2′

1901.206	90°5	51″44
1902.222	90.5	51.20
1901.71	90.5	51.32

The only other measures are:

1825.17	90°5	51″84	2n	S

S 611. S.D.(13°)3193-4. 9 . . . 9

R.A. = 10h 35m 53s
Decl. = − 14° 5′

1902.145	193°9	59″60
.219	193.3	59.55
1902.18	193.6	59.57

The only other measure is:

1825	193°8	59″33	1n	S

H 838. 41 *Sextantis.* 6 . . . 11.7

R.A. = 10h 44m 17s
Decl. = − 8° 16′

1901.299	303°9	27″04
.337	302.2	27.06
1901.32	303.0	27.05

The only other measures are 303°8 : 26″95 (1878.18) 1n β. H called the small star 17–18m.

S 617. 6.6 . . . 8.5

R.A. = 10h 47m 19s
Decl. = − 1 37′

1901.167	177°8	35″25
.203	178.3	35.42
1901.18	178.0	35.33

The proper motion in the A.G. is 0″130 in 230°1 for each star. The components are L 20956 and 20957.

1800	179°7	34″11		Lalande
1824.22	177.8	35.22	2n	S
1880.66	178.6	35.09	3n	Schiap

H 4410. O.Arg.S.11162. 7.5 . . . 13

R.A. = 11h 2m 19s
Decl. = − 15° 19′

1901.206	222°6	19″33
.299	221.8	19.71
1901.25	222.2	19.82

Only H, 205°3 : 15″ (1836.4). He calls it "difficult," so the apparent change in angle may not be real.

H 177. S.D.(2°)3297. 9.6 . . . 10.1

R.A. = 11h 3m 21s
Decl. = − 2° 46′

1901.206	128°1	4″93
.299	131.1	4.87
1901.25	129.6	4.90

H gives 110° ± : 2″, and says, "hardly divided with the sweeping power."

Σ 1518 *rej.* D.M.(6°)2421. 7.5 . . . 9.7 . . . 9.9

R.A. = 11ʰ 8ᵐ 18ˢ
Decl. = + 5° 55′

B and C (= Σ 1518 *rej.*)

1901.167	350°.5	2″.80
.299	353.0	3.69
.318	353.2	3.72
1901.26	352.2	3.40

A and B

1901.167	256°.7	103″.49
.299	256.2	103.52
1901.23	256.4	103.50

No other measures. Described as Class I in Σ.

W² XI. 621.

R.A. = 11ʰ 33ᵐ 17ˢ
Decl. = + 21° 59′

This star (= D.M.(22°)2387) is noted "duplex 3″" in Weisse. Examined on two nights in 1901, but not seen double or with any near companion. It is a curious fact that in the Berlin A.G. this star has the note, "Comp. 9.5 1″ – 2″ ?" It is about 1ᵐ *p* 93 *Leonis*. I examined the star in question in May, 1874, with the 6-in. without seeing it double.

H 2955

R.A. = 11ʰ 59ᵐ 16ˢ
Decl. = + 39° 20′

The description in H is 315°± : 15″± : 8 . . . 18 (1830); "extremely faint." Examined on two nights, and no companion visible.

Σ 1601

R.A. = 12ʰ 0ᵐ 2ˢ
Decl. = + 39° 30′

1901.203	311°.6	2″.45
.318	311.7	2.31
1901.26	311.6	2.38

Measured in looking for the preceding pair, H 2955.

H 203. W¹ XII. 91. 6.8 . . . 12.7

R.A. = 12ʰ 8ᵐ 6ˢ
Decl. = + 5° 3′

1901.203	351°.9	26″.62
.206	351.3	25.77
.318	350.7	26.18
1901.24	351.3	26.19

The only other measures are:

1878.24	351°.6	30″.20	1*n*	β

The principal star has a proper motion of 0″.184 in 319°.5, which evidently does not belong to the small star.

Ho 52. 11 *Comae.* 5 . . . 12.3

R.A. = 12ʰ 14ᵐ 39ˢ
Decl. = + 18° 27′

1901.203	45°.4	9″.15
.299	41.6	9.16
.356	43.7	9.13
1901.28	43.6	9.15

The large star has a proper motion of 0″.145 in 308°.3. Comparing these positions with those of Hough in 1892, it is very probable that the small star has the same movement.

Albany A.G. D.M.(2°)2550. 8.5 . . . 8.8

R.A. = 12ʰ 25ᵐ 5ˢ
Decl. = + 2° 46′

1901.356	286°.9	1″.40
.375	287.5	1.24
1901.36	287.2	1.32

Noted "duplex?" in the Albany Catalogue. This is a new pair; no other measures.

Pritchett.

R.A. = 12ʰ 31ᵐ 0ˢ
Decl. = – 7° 0′

A double star is given in this place in the Morrison Observations, 76°.8 : 5″.89 (1880.36) 1*n*; magnitudes not given. I carefully examined the place and vicinity without finding any pair of this description. It should be a short distance *p* the 5m star, 26 *Virginis*.

H 522. 30 *Comae.* 6 . . . 11.7

R.A. = 12ʰ 45ᵐ 51ˢ
Decl. = + 28° 13′

1901.318	11°.8	42″.46
.337	11.3	43.22
.356	12.0	43.08
1901.31	11.7	42.92

The only other measures are 10°.0 : 43″.17 (1878.15) 1*n* β. H gave the magnitudes 6 and 18. His R.A. is about 2½ᵐ too small. The proper motion is 0″.115 in 287°.7.

δ *Virginis.* 3½ . . . 10.5

R.A. = 12h 49m 34s
Decl. = + 4° 3′

1901.203	139°2	157″81
.263	140.2	158.26
.414	139.4	158.13
1901.29	139.6	158.07

The principal star has a proper motion of 0″499 in 263°1. The only other measures are:

1879.30	142°3	152″03	2*n*	β

The computed place of the companion for 1901, from the first measures and the proper motion, is 139°9 : 158″00.

H 2645. 53 *Virginis.* B = 11.8

R.A. = 13h 5m 40s
Decl. = − 15° 33′

1901.299	7°3	77″59
.318	6.9	76.52
.356	7.8	77.16
1901.32	7.3	77.09

No other measures. H estimates 30° ± : 50″ ± (1830). The large star has a proper motion of 0″289 in 164°8.

OΣ 261

R.A. = 13h 6m 24s
Decl. = + 32° 31′

1889.288	344°9	1″45

Sh 162. 7.2 . . . 7.7

R.A. = 13h 8m 39s
Decl. = − 10° 43′

1902.145	50°8	71″14
.219	50.5	71.30
1902.18	50.6	71.22

The principal star has a proper motion of 0″388 in 219°4. The components are respectively L 24582 and 24584.

1823.34	61°7	44″85	1*n*	Sh
1881.37	52.5	64.60	3*n*	β

H̥ IV. 119. S.D.(12°)3802. 7.5 . . . 10

R.A. = 13h 16m 25s
Decl. = − 12 33′

1902.145	312°2	19″29
.219	310.5	19.04
1902.18	311.3	19.16

The companion is S.D.(12°)3801. This pair has been entirely neglected by observers since H̥, and the only measures are:

1783.18	306°9	21″82	1*n*	H̥

Σ 1739 *rej.* D.M.(31°)2478. 9.2 . . . 10

R.A. = 13h 16m 57s
Decl. = + 31 9

1902.145	132°7	12″93
.219	131.7	12.63
1902.18	132.2	12.78

No other measures.

75 *Virginis.* 5 . . . 13.5 . . . 12

R.A. = 13h 26m 27s
Decl. = − 14° 45′

A and B

1902.145	321°0	18″82
.219	319.3	18.98
1902.18	320.1	18.90

A and C (= H 2658)

1902.145	109°9	79″74
.219	110.1	79.50
1902.18	110.0	79.62

The faint star not previously seen. The only complete measures of AC are:

1879.31	110°1	78″29	2*n*	β

Σ 1757

R.A. = 13h 28m 9s
Decl. = + 0° 18′

1901.203	76°7	2″41
.263	78.8	2.59
.280	78.9	2.35
1901.25	78.1	2.45

Although two orbits have been computed of this pair, the motion seems to be purely rectilinear, the change being due to the difference of the two proper motions. That of the principal star is 0″270 in 277°9. (See *Popular Astronomy*, IV, 172.)

H 2659

R.A. = 13h 28m 11s
Decl. = + 40° 33′

The description in H is 315 ± : 10″ : 8–9 . . . 18; "requires verifying." I could not see this companion

with the $18\frac{1}{2}$-in. in 1878, nor with the 40-in., 1901.20. The nearest star is 13m, 202°.3 : 38″.7. It is probable that H was mistaken. His place is that of D.M.(40°) 2666, given as 7.4m.

β 611

R.A. = 13h 31m 15s
Decl. = − 14° 7′

1901.299	260°.5	4″.56
.356	260.1	4.79
1901.33	260.3	4.67

Measured in looking for the Egbert pair.

H 2666. S.D.(14°)3763

R.A. = 13h 32m 2s
Decl. = − 14° 13′

1901.299	177°.6	13″.83
.318	179.4	14.87
.356	182.4	14.19
1901.32	179.8	14.30

H gives 176°.7 : 8″± : 9 . . . 15 (1830).

Egbert

R.A. = 13h 34m :
Decl. = − 14° 26′ :

Measured once at Cincinnati, 319°.3 : 11″.70 : 9 . . . 10 (1879.30). There is no such pair in or near this place. About $2^m f$ there is a small pair, 0°.5 : 15″.43 : 8.5 . . . 13.5 (1901.35) 1*n*. This star is S.D.(14°)3783. The descriptions do not correspond. β 611 is in the same vicinity.

Σ 1774 *rej.* 7 . . . 10.5

R.A. = 13h 35m 39s
Decl. = + 51° 7′

1901.337	133°.7	17″.87
.356	134.1	17.83
1901.34	133.9	17.85

The principal star is given in Harvard A.G. a proper motion of 0″.172 in 305°.1. The only prior measures are:

1879.26	134°.2	17″.93	1*n*	β

The distance now should be 3″.7 more, if the proper motion is correct and the small star is fixed.

H 2676. D.M.(50°)2021. 7.8 . . . 9.7

R.A. = 13h 38m 12s
Decl. = + 50° 38′

1901.337	126°.0	29″.67
.356	125.0	29.66
1901.34	125.5	29.66

Recently measured by Espin. Nothing else since H.

Σ 1782.

R.A. = 13h 39m 22s
Decl. = + 18° 58′

1902.145	185°.6	29″.72
.219	185.0	29.67
1902.18	185.3	29.69

No recent measures, but unchanged.

Howe. D.M.(6°)2824. 9 . . . 9.1 . . . 11

R.A. = 13h 57m 22s
Decl. = + 6° 22′

A and B

1901.203	65°.6	0″.93
.263	64.9	0.92
1901.23	65.2	0.92

AB and C

1901.203	189°.3	14″.33
.263	188.7	14.20
1901.23	189.0	14.26

No recent measures. Probably unchanged. Identified as above.

Σ 1801

R.A. = 13h 59m 27s
Decl. = + 6° 32′

1901.203	67°.5	19″.51
.263	68.4	19.72
1901.23	67.9	19.61

Howe. S.D.(12°)3958. 8.2 . . . 8.7

R.A. = 13h 59m 30s
Decl. = − 12° 30′

1901.203	7°.5	13″.46
.225	7.6	13.31
.299	7.6	13.31
1901.24	7.6	13.38

The original place is only approximate. The R.A. is about 2^m in error. The only other measures are in 1879. Apparently fixed.

13 *Bootis*. H VI. 112. 5 . . . 9.5

R.A. = $14^h\ 3^m\ 48^s$
Decl. = $+50°\ 1'$

1902.219	274°.3	81″.14
.222	274.4	80.99
1902.22	274.3	81.06

The companion is preceding the other. The only measures are:

1783.63	82°.6	77″.97	1*n*	H
1879.33	95.0	83.47	1*n*	Cin

The proper motion of the principal star is very small, 0″.06 in 323°.

Σ 1807

R.A. = $14^h\ 5^m\ 6^s$
Decl. = $-\ 2°\ 46'$

1901.203	28°.8	6″.88
.299	26.0	6.88
1901.25	27.4	6.88

H 1248. 12 . . . 12.2

R.A. = $14^h\ 9^m\ 58^s$
Decl. = $+\ 7°\ 54'$

1901.356	163°.2	7″.90
.370	163.9	7.99
1901.36	163.5	7.94

H gives 340°± : 2″± : 16 . . . 16.17 (1828), and says, "The most minute double star I have hitherto seen." It is a little *s* of the 9.4m star, D.M.(8°)2834. As in nearly all cases of this kind, H greatly underestimated the distance.

Howe. D.M.(24°)2711. 8.5 . . . 10.0

R.A. = $14^h\ 11^m\ 6^s$
Decl. = $+\ 24°\ 2'$

1902.145	79°.2	3″.35
.219	78.6	3.48
1902.18	78.9	3.41

Howe (Cin.[5]) measured a pair in this place, 193°.7 : 5″.42 : 8.5 . . . 10.5 (1879.35) 1*n*. Unless there is a large error in the measure or the place, there would seem to be considerable relative motion. There is no other pair in the vicinity.

Espin. D.M.(52°)1792. 9 . . . 10.3 . . 9

R.A. = $14^h\ 16^m\ 15^s$
Decl. = $+\ 52°\ 13'$

A and B

1902.145	46°.8	1″.75
.219	47.8	1.68
1902.18	47.3	1.71

A and C

1902.145	170°.6	40″.83
.219	170.1	40.86
1902.18	170.3	40.84

Discovered by Espin. No other measures of AB. The A.G. positions give for AC 190°.1 : 41″.75 (1875.7).

H 2714. (= Ho 385). 7 . . . 11

R.A. = $14^h\ 17^m\ 18^s$
Decl. = $-\ 19°\ 15'$

1901.263	280°.1	23″.09
.280	278.4	23.05
1901.27	279.2	23.07

The angle seems to be increasing; 266°.4(1830)H; 276°.1(1879)β; 277°.0(1891)Ho. The principal star is L 26283.

H 546. S.D.(12°)4012. 7 . . . 10.4

R.A. = $14^h\ 18^m\ 48^s$
Decl. = $-\ 12°\ 49'$

1902.145	42°.6	39″.35
.219	42.2	39.43
1902.18	42.4	39.39

The R.A. in H is 4^m too small, and the Decl. about 1° too small. He called the components red and blue. No other measures.

Σ 1852 *rej*. B.A.C. 4799. 7.2 . . . 9.5

R.A. = $14^h\ 23^m\ 45^s$
Decl. = $-\ 3°\ 43'$

1901.225	267°.9	24″.74
.263	268.1	24.63
1901.24	268.0	24.68

No early measures. β 268°.1 : 25″.16 (1879.30) 3*n*.

H 2728. ρ *Bootis.* 4 . . . 12.5

R.A. = 14ʰ 26ᵐ 42ˢ
Decl. = + 30° 54′

1902.145	335°.9	50″.14
.219	335.8	49.98
1902.18	335.8	50.06

Meridian positions give for the proper motion 0″.151 in 316°.9. The earliest complete measures are:

1879.87	331°.0	53″.25	2*n*	β

Hd Zones. D.M.(1°)2964

R.A. = 14ʰ 35ᵐ 38ˢ
Decl. = + 0° 51′

In Harvard Zones "appeared elongated." I could see no sign of duplicity (1901.20). If double, it must be very close.

Sh 186. α *Librae*

R.A. = 14ʰ 44ᵐ 12ˢ
Decl. = − 15° 32′

1901.280	314°.0	231″.08
.299	314.2	230.97
1901.29	314.1	231.02

No recent measures. The smaller star is 8 *Librae*. Auwers gives 0″.168 in 237°.6 for the p.m. of A, and 0″.153 in 241°.9 for the other.

1755	314°.9	231″.18	Bradley
1823	314.5	230.85	Sh
1880	314.4	230.70	Gr. 10-year

H 564. D.M.(29°)2618. 8 . . . 11.4

R.A. = 14ʰ 59ᵐ 11ˢ
Decl. = + 29° 33′

1901.206	32°.9	41″.18
.225	32.6	41.34
1901.21	32.7	41.26

H gives 20 ± : 15″ ± : 6 . . . 20 (1820). There is no bright star in his place. The one measured has the same R.A., but is about 20 s. and is probably the star in question.

Σ 1936. D.M.(27°)2178

R.A. = 15ʰ 16ᵐ 2ˢ
Decl. = + 27° 28′

1901.206	231°.5	20″.36
.318	232.0	20.30
1901.26	231.7	20.33

No recent measures, and only Ma and Δ since Σ. Put on the list to identify and get correct place. Error in *Mens. Microm.* Without change.

OΣ (App.) **140.** 8 . . . 8

R.A. = 15ʰ 26ᵐ 38ˢ
Decl. = + 8° 59′

1901.471	179°.7	111″.96
.512	179.8	112.32
1901.49	179.7	112.14

The only other measures are by Δ, 179°.9 : 111″.85 (1874.97) 2*n*. The components are L 28309 and 28310.

γ *Librae.* 4.5 . . . 11.7

R.A. = 15ʰ 28ᵐ 48ˢ
Decl. = − 14° 23′

1901.471	152°.5	42″.04
1902.219	152.9	41.81
1901.84	152.7	41.92

Companion first noted by Goldschmidt (*Comp. Rend.* LVI, 845). The only previous measure is:

1878.32	151°.8	41″.31	1*n*	β

OΣ 297. 8 . . . 11.5

R.A. = 15ʰ 29ᵐ 40ˢ
Decl. = + 25° 25′

1901.318	138°.6	4″.24
.320	136.2	4.81
.395	137.1	4.77
1901.34	137.3	4.61

The change is due to proper motion. I do not find this is given from meridian positions. From all the measures Hussey gets 0″.149 in 156°.5 for the movement of A.

W² XV. 752 = D.M.(23°)2838

R.A. = 15ʰ 33ᵐ 10ˢ
Decl. = + 23° 4′

Noted in Weisse "duplex ?" A 7.4m star, and certainly not double (1901.28).

D.M.(4°)3055. 8.5 . . . 9.0

R.A. = 15ʰ 39ᵐ 22ˢ
Decl. = + 4° 55′

1901.375	146°.3	2″.19
.395	144.9	2.09
1901.38	145.6	2.14

Noted as double, 160″ : 2′, in the Albany A.G. Not in any double-star catalogue, and no other measures.

Pritchett. D.M.(36°)2640. 9 . . . 9

R.A. = 15ʰ 40ᵐ 12ˢ
Decl. = + 35° 59′

1901.359	44°.4	4″.46
.395	46.0	4.58
1901.38	45.2	4.52

Discovered by Pritchett, who found 45°.1 : 3″.91 (1881.52) 1*n*. No other measures.

Skinner. S.D.(16°)4169. 8.5 . . . 8.7

R.A. = 15ʰ 45ᵐ 32ˢ
Decl. = − 16° 52′

1901.455	275°.2	2″.02
.471	273.0	2.00
1901.46	274.1	2.01

Noted as double by Professor Skinner at the Naval Observatory. No other measures.

H 1281. L 28977. 7.1 . . . 11

R.A. = 15ʰ 50ᵐ 17ˢ
Decl. = − 15° 41′

1901.280	230°.9	34″.43
.299	231.3	34.38
1901.29	231.1	34.40

H estimated 215° : 18″ : 6-7 . . . 20. The only other measures are 229°.8 : 35″.12 (1890.36) 1*n* β.

W² XVI. 2. 8.4 . . . 9.2

R.A. = 16ʰ 2ᵐ 27ˢ
Decl. = + 20° 42′

1901.356	224°.6	12″.12
.375	224.9	12.22
1901.36	224.7	12.17

In Weisse "duplex 12″." No other measures.

Σ 2017

R.A. = 16ʰ 6ᵐ 37ˢ
Decl. = + 14° 52′

1900.455	252°.9	26″.64
.458	252.8	26.55
1900.45	252.8	26.60

Perhaps a small change in distance. Σ found 25″.03 (1831.42), and ⅃ 25″.95 (1867.65).

Σ 2018 *rej.* S.D.(7°)4234. 8.4 . . . 9.1

R.A. = 16ʰ 7ᵐ 10ˢ
Decl. = − 7° 20′

1901.359	355°.3	19″.51
.375	355.8	19.36
.455	355.0	19.60
1901.39	355.4	19.51

No other measures. Identified as above.

Σ 2019 *rej.* S.D.(10°)4276. 8 . . . 9.2

R.A. = 16ʰ 7ᵐ 42ˢ
Decl. = − 10° 7′

1900.455	152°.7	22″.48
.458	153.0	22.25
1900.45	152.8	22.36

The only other measures are in the Washington Observations of 1862, 109°.2 : 19″.11 (1862.7). This may be another star.

Σ 2031 *rej.* D.M.(−1°)3761. 7.6 . . . 9.7

R.A. = 16ʰ 10ᵐ 9ˢ
Decl. = − 1° 21′

1901.359	230°.2	20″.80
.395	229.5	20.85
.416	230.0	20.66
1901.39	229.9	20.77

No other measures; Class IV in Σ. The principal star is L 29649, and has a proper motion of 0″.105 in 270°.

σ *Coronae*

R.A. = 16ʰ 10ᵐ 12ˢ
Decl. = + 34° 10′

A and B (= Σ 2032)

1901.263	213°.6	4″.34
.320	212.8	4.30
1901.29	213.2	4.32

B and C (= OΣ 538)

1901.263	202°.7	5″.58

The distance of the 13.5m star is diminishing from the proper motion of AB.

Σ 3103 *rej.* S.D.(3°)3921. 8.8 . . . 9.7

R.A. = 16ʰ 14ᵐ 24ˢ
Decl. = − 3° 40′

1901.395	305°.3	24″.18
.414	304.9	24.56
1901.40	305.1	24.37

No other measures.

β 624

R.A. = 16h 15m 42s
Decl. = − 22° 50′

1901.359	320°.4	1″.19
.433	323.5	1.21
1901.40	321.9	1.20

Observed in trying to find H 4851.

Anon. S.D.(3°)3929, 3930. 7.6 . . . 8.7

R.A. = 16h 16m 14s
Decl. = − 3° 58′

1901.375	22°.1	99″.70
.416	22.5	99.97
1901.39	22.4	99.83

Measured in connection with Σ 3103 *rej.* The meridian positions in Lamont give 22°.7 : 92″.44 (1855.5).

H 4851

R.A. = 16h 17m 7s
Decl. = − 22° 45′

The description in H is 96°.9 : 15″± : 8 . . . 11 (1837.2). I looked in vain for this object in 1891, and again in 1901. There is no such star in or near this place. I see now that there is an error of 1h R.A. in this place, and that the star is identical with H 4948, which is 17h 17m 10s; −22° 42′. The descriptions correspond perfectly. Measures of that will be found here in the proper place.

Σ 2038 *rej.* D.M.(2°)3091. 8.6 . . . 10.4

R.A. = 16h 17m 29s
Decl. = + 2° 30′

1901.455	214°.7	16″.49
.471	213.7	16.41
1901.46	214.2	16.45

No other measures.

Σ 2042 *rej.* D.M.(6°)3225. 8.3 . . . 11.1

R.A. = 16h 19m 56s
Decl. = + 5° 59′

1901.375	108°.9	20″.28
.395	108.3	20.58
.414	109.4	20.20
1901.39	108.9	20.35

No other measures.

β 815. D.M.(43°)2605. 8.3 . . . 10.5

R.A. = 16h 23m 16s
Decl. = + 43° 11′

A and B

1901.375	340°.8	9″.19
.395	340.9	9.09
.397	340.2	9.22
.414	340.2	9.13
.416	340.7	9.28
1901.40	340.56	9.18

A and C (C = 11.5)

1901.375	160°.4	67″.71
.395	160.4	67.79
.397	160.6	67.95
.414	161.5	67.55
.416	160.6	67.80
1901.40	160.7	67.76

B and C

1901.375	160°.3	76″.95
.395	160.3	77.40
.397	160.7	77.15
.414	160.9	77.09
.416	160.5	77.23
1901.40	160.5	77.16

It will be remembered that B has a large proper motion for so small a star. I have measured the faint star C, which is exactly in line with AB, for the purpose of determining whether any of the change in AB is due to the movement of A. I have also compared the latter star with D.M.(43°)2608, and find for the difference of Declination 22″.52 (1901.41). This difference in the A.G. is 22″.2, so that it is practically certain that A has no appreciable proper motion. My measures of AB in 1881, and those given here, give for the proper motion of B, 0″.147 in 323°.3.

Sh 233

R.A. = 16h 25m 43s
Decl. = + 8° 33′

1900.551	71°.3	58″.90
1901.210	71.1	58.80
1900.88	71.2	58.85

Relatively fixed. 71°.8 : 58″.86 (1858.48) 2*n* OΣ. In 1874 I thought that one of these stars was a close double, but both were round in the last measure with fine seeing.

Hd Zones. L 30078. 9 . . . 9.1

R.A. = 16h 26m 10s
Decl. = + 0° 28′

1901.375	305°.7	6″.94
.414	303.3	6.94
.455	305.7	6.92
1901.41	304.9	6.93

Noted as double in the Harvard Zones, and also in the Göttingen Catalogue. No other measures. In the field about 3′s is a 10m star with a double companion.

H 4864. S.D.(6°)4457. 9.5 . . . 12.8

R.A. = 16h 26m 49s
Decl. = − 6° 19′

A and B

1900.455	91°.4	10″.07
.458	89.8	10.25
1901.433	87.7	10.39
1900.78	89.6	10.24

A and C (C = 14.5)

1900.455	134°.8	13″.55
.458	140.4	13.22
1900.45	137.6	13.38

Simply described in H as "triple Classes I and II." There is a 10m star, 234°.3 : 73″.2.

Σ 2062. 8.4 . . . 10.5

R.A. = 16h 28m 42s
Decl. = + 8° 56′

1900.458	111°.5	2″.55
.551	113.6	2.50
1900.50	112.5	2.52

The only measures since 1857 are my own in 1880. There is no change.

Young. D.M.(58°)1616. 8.2 . . . 9.5

R.A. = 16h 29m 26s
Decl. = + 58° 1′

1901.375	216°.5	1″.30
.433	214.9	1.48
1901.40	215.7	1.38

Discovered by Professor Young, 219°.5 : 1″.59 (1883.76) 1*n*.

Σ 2069 *rej.* L 30278. 6.8 . . . 10.4

R.A. = 16h 31m 55s
Decl. = + 34° 4′

1901.356	72°.6	26″.82
.375	71.8	26.56
.395	71.1	26.62
1901.37	71.8	26.67

No other measures.

Σ 2081 *rej.* L 30416. 7.8 . . . 10.5

R.A. = 16h 37m 4s
Decl. = + 3 41′

1901.375	321°.9	21″.31
.414	322.2	21.40
1901.39	322.0	21.35

A more distant companion of about same magnitude, 178°.2 : 42″.3. No other measures.

Σ 2093 *rej.* η *Herculis.* 3 . . . 12

R.A. = 16h 38m 47s
Decl. = + 39° 9′

1901.337	262°.2	114″.27
.356	262.2	114.27
1901.34	262.2	114.27

Principal star round. The only measures of the small star are 261°.1 : 113″.39 (1879.27) 1*n* β.

Skinner. S.D.(17°)4630. 8.4 . . . 8.5

R.A. = 16h 39m 20s
Decl. = − 17° 8′

1901.455	86°.7	3″.46
.473	85.5	3.69
1901.46	86.1	3.57

Discovered by Professor Skinner at the Naval Observatory with the meridian instrument. No other measures.

H 1294. L 30509. 7 . . . 12.5

R.A. = 16h 40m 56s
Decl. = − 24° 19′

1900.455	131°.3	24″.95
1901.433	132.3	25.03
1900.94	131.8	24.99

No other measures. H gives 135 ± : 18″ ± : 7 . . . 17; "large star red." To me it appeared yellow only.

Σ 3108 *rej.* L 30915. 8.4 . . . 9.0

R.A. = $16^h 55^m 43^s$
Decl. = $-11° 43'$

1901.455	124°8	39″60
1902.219	124.7	39.73
1901.83	124.7	39.66

No other measures.

Howe. S.D.(10°)4619. 8.7 . . . 12.7

R.A. = $16^h 56^m 41^s$
Decl. = $-20° 13'$

1900.455	180°9	6″15
1902.430	174.0	6.21
1901.44	177.4	6.18

The only prior measure is a single observation of the position-angle 182.6 (1879.55), with only approximate place. H 4911, which is about $2\frac{1}{3}^m p$ of this, was suspected by H to have a small companion. I have looked for it several times. It is certainly single. His place is that of O.Arg.S. 16213.

H 2804. 9.5 . . . 9.6

R.A. = $17^h 0^m 31^s$
Decl. = $+39° 9'$

1902.219	277°7	15″14
.433	277.8	15.19
1902.32	277.7	15.16

Not in D.M. Previous measures discordant.

1830+	283°8	20″ ±	1*n*	H
1880.48	280.4	17.25	2*n*	Bigourdan
1900.53	278.3	15.44	2*n*	Espin

Σ 2144 *rej.* S.D.(7°)4419. 7.6 . . . 10.2

R.A. = $17^h 10^m 53^s$
Decl. = $-7° 41'$

1901.375	182°8	25″65
.414	182.4	25.25
1901.39	182.6	25.45

The only other measure is a single observation by Mitchell, 4°0 : 25″73 (1848.60). The angle should be reversed.

Σ 2149.

R.A. = $17^h 13^m 32^s$
Decl. = $-6° 18'$

1901.203	24°1	7″34
1902.430	24.8	7.42
1901.81	24.4	7.38

The previous measures of this pair are very discordant in distance, but there is probably no change since Σ, who found 23°2 : 7″47 (1830.15).

σ 544. 72 *Herculis.* 5 . . . 9.6

R.A. = $17^h 16^m 10^s$
Decl. = $+32° 38'$

A and B

1900.473	332°6	207″33
.476	332.0	207.76
1900.47	332.3	207.54

B and C (C = 12.5)

1900.473	216°1	8″64
.476	217.5	8.73
1900.47	216.8	8.68

The change in B is due to the proper motion of A, 1″037 in 174°1. No other complete measures of C.

H 4948. S.D.(22°)4341. 8.3 . . . 9.8

R.A. = $17^h 17^m 9^s$
Decl. = $-22° 11'$

1901.433	106°2	12″91
.455	105.2	13.37
.512	104.8	13.13
1901.47	105.4	13.14

H 4854 has an error of 1^h in the R.A. and is identical with the pair measured.

OΣ 329 *rej.* (= S 688). L 31771

R.A. = $17^h 20^m 17^s$
Decl. = $+37° 3'$

1900.458	12°7	32″74
1901.320	12.2	32.62
1900.89	12.4	32.68

Without change.

H 1299. L 31783. 7 . . . 12 . . . 12.5

R.A. = $17^h 21^m 12^s$
Decl. = $+26° 59'$

A and B

1901.375	21°0	50″53
.395	19.9	50.78
1901.38	20.4	50.65

A and C

1901.375	57°.5	52″.69
.395	57.6	52.55
1901.38	57.5	52.62

H gives for the angles 20°.7 and 60°.5 (1828).

Σ 2189 *rej.* 7.9 . . . 10.3 . . . 8.6

R.A. = 17h 29m 37s
Decl. = + 47° 58′

A and B

1901.356	100°.5	20″.88
.375	100.0	21.06
.433	99.4	21.27
1901.39	100.0	21.07

A and C

1901.356	359°.6	65″.11
.375	359.2	64.96
.433	359.9	65.06
1901.39	359.6	65.04

A and C are D.M.(48°)2532 and 2533. The only measures of AB are 98°.5 : 20″.58 (1900.53) 2*n* Espin.

Hd Zones

R.A. = 17h 32m 14s
Decl. = + 0° 56′

Noted as "double" in Harvard Zones. The place is that of the 9.2m star, D.M.(0°)3739. It is not double.

Skinner. S.D.(15°)4651. 8.5 . . . 9.0

R.A. = 17h 35m 20s
Decl. = − 15° 40′

1901.512	275°.8	4″.33
.586	276.0	4.29
1901.55	275.9	4.31

Discovered by Skinner with the meridian circle of the Naval Observatory. It is also Hussey 184.

Σ 2195 *rej.* 9 . . . 9

R.A. = 17h 36m 13s
Decl. = + 21 13′

1901.414	101°.3	21″.60
.416	101.0	21.61
1901.41	101.1	21.60

No other measures. In the field 2′ or 3′ *p* Σ 2196.

H 4986. O.Arg.S.17253 8.2 . . . 11.2

R.A. = 17h 42m 50s
Decl. = − 26° 18′

1901.375	226°.2	10″.26
.433	226.7	11.04
.452	226.5	10.56
1901.42	226.5	10.62

No measures. H gives 330°± : 12″± (1834.3); probably error of 100°. There is a 13m star 5°.4 : 22″.9, and 12.5m at 61°.4 : 27″.2.

Σ 2230

R.A. = 17h 44m 54s
Decl. = + 7 57′

A and B

1900.458	108°.8	37″.52
.515	109.1	37.72
1900.48	108.9	37.62

A and C

1900.458	83°.2	45″.45
.515	84.3	45.50
1900.48	83.7	45.47

B and C

1900.458	208°.5	19″.26
.515	211.0	19.05
1900.48	209.7	19.15

The principal star has a small proper motion of about 0″.017, which increases the distances of both companions.

H 4995. L 32695. 6.7 . . . 11.7

R.A. = 17h 47m 26s
Decl. = − 11° 19

1900.551	154°.6	28″.60
1901.263	156.1	28.48
1900.96	155.3	28.54

H has 140°± : 18″±; "a third, closer, suspected." Neither this telescope nor the 18½-in. in 1878 showed any other companion.

OΣ (*App*) **160.** 8.2 . . . 8.6

R.A. = 17h 47m 46s
Decl. = + 10 59

1900.458	190°.8	102″.30
.476	191.0	102.14
1900.46	190.9	102.17

Σ did not find this, and there are no other measures. The components are D.M.(10°)3315 and 3314. The A.G. positions give 191°.6 : 100″.87.

Holden. L 32716. 6.7 . . . 12

R.A. = 17h 48m 13s
Decl. = − 11 37′

1900.551	154°.3	3″.51
.553	150.0	3.56
1900.55	152.1	3.53

Discovered by Professor Holden at the Washburn Observatory. Unchanged.

Bird. O.Arg.N.17688. 9 . . . 10.5 . . . 9

R.A. = 17h 52m 55s
Decl. = + 67 1′

A and B

1901.375	325°.4	11″.83
.433	326.3	11.65
1901.40	325.8	11.74

A and C

1901.375	328°.5	22″.28
.433	328.6	22.40
1901.40	328.5	22.34

B and C

1901.375	333°.5	10″.28
.433	331.9	10.35
1901.40	332.7	10.31

The wide pair AC "duplex" in O.Arg. The faint star between discovered by F. Bird in 1869. The only other measures are mine in 1879.

Σ 2253

R.A. = 17h 52m 55s
Decl. = + 14° 38′

1901.203	78°.4	15″.22
.225	78.2	15.50
1901.21	78.3	15.36

Distance slowly decreasing.

OΣ (*App*) 161

R.A. = 17h 54m 29s
Decl. = + 8° 52′

1901.375	76°.7	62″.36
.436	77.2	62.20
.471	76.8	62.27
1901.43	76.9	62.28

The only other measures are by Δ, 77°.9 : 62″.70 (1874.98) 3*n*.

W[1] XVII. 1120

R.A. = 17h 55m 22s
Decl. = − 14 30′

"Duplex" in Weisse. This is S.D.(14°)4860, 8.7m Not double, and no near companion.

S 698. L 33058. 7 . . . 8

R.A. = 17h 56m 57s
Decl. = − 22° 30′

1900.551	316°.1	29″.70
1901.263	317.0	29.52
1900.90	316.5	29.61

No other measures since South, 317°.4 : 30″.92 (1825.51) 2*n*. There are many stars in the field, and several nearer than B.

H 5013. S.D.(15°)4801. 9.7 . . . 11.7

R.A. = 17h 57m 38s
Decl. = − 15 5′

1901.455	338°.4	13″.31
.529	338.6	13.53
1901.49	338.5	13.42

The only observations by H, 339 ± : 4″ ± : 9 . . . 13.

A.C. 15. 99 *Herculis*

R.A. = 18h 2m 28s
Decl. = + 30 23

1898.269	317°.5	1″.04
.271	322.4	1.21
.463	320.8	1.19
1898.33	320.2	1.15

Perry. 10.2 . . . 11.0

R.A. = 18h 3m ±
Decl. = + 9 20 ±

1900.551	313°.1	3″.28
1902.433	313.1	3.37
1901.49	313.1	3.32

Not in D.M. It is about 1m*f* D.M.(9°)3565. The only other observation is 305°.0 : 2″.0 (1881.38) Perry.

Alvan G. Clark. 102 *Herculis.* 5½ . . . 12.9

R.A. = 18h 3m 38s
Decl. = + 20° 48′

1900.458	135°.9	23″.66
.473	135.6	23.72
1901.455	136.5	23.28
1900.76	135.7	23.55

The only prior measures are mine, 136°7 : 23″42 (1878.45) 1*n*. This angle is erroneously printed 46°7. The proper motion of A is small, 0″015 in 212°9.

Σ 2285

R.A. = 18ʰ 3ᵐ 45ˢ
Decl. = + 13° 28′

1900.458	333°6	3″50
1901.203	333.2	3.45
1900.83	333.4	3.47

Without change. No late measures.

H 593. S.D.(17°)5052. 8.2 . . . 11.5 . . . 9.5

R.A. = 18ʰ 3ᵐ 48ˢ
Decl. = − 17 10′

A and C

1901.455	303°4	18″15
.512	301.1	18.08
1901.48	302.2	18.11

A and B (= Hussey 195)

1901.512	75°8	1″14

Close pair discovered by Hussey in 1900. No other measures of H 593 except Glasenapp, 300°9 : 17″26 (1890.54) 2*n*.

H 5030. L 33330. 6 . . . 10.8

R.A. = 18ʰ 4ᵐ 24ˢ
Decl. = − 23 44′

1901.263	287°3	41″65
.586	287.3	42.24
1901.42	287.3	41.94

The only other measure is:

1834.3	281°0	30″±	1*n*	H

H 2820. 9.5 . . . 10.7 . . . 10.8

R.A. = 18ʰ 4ᵐ 45ˢ
Decl. = − 18 26′

A and B

1901.455	279°3	5″58
.529	278.3	5.72
1901.49	278.8	5.65

A and C

1901.455	82°7	12″87
.529	83.8	13.10
1901.49	83.2	12.98

The principal star is S.D.(18°)4826. The only other observations by H, 281°9 : 3″±; 90°0 : 8″± (1830).

Σ 2291

R.A. = 18ʰ 5ᵐ 53ˢ
Decl. = + 34° 0

1900.473	339°3	27″01
1901.299	339.0	26.85
.320	339.4	26.53
1901.03	339.2	26.80

No recent measures. Distance increasing?

1830.73	339°2	25″12	2*n*	Σ
1868.02	339.2	25.90	4*n*	⅃

H 1821. S.D.(16°)4755. 9.2 . . . 9.6

R.A. = 18ʰ 5ᵐ 54ˢ
Decl. = − 16° 20′

1901.529	278°0	8″00
1902.433	278.0	7.62
1901.98	278.0	7.81

H has 273°6 : 4″± (1828).

A and S.D.(16°)4756

1901.529	13°6	53″07
1902.433	13.4	53.25
1901.98	13.5	53.16

H V. 93. D.M.(28°)2955 and 2956

R.A. = 18ʰ 8ᵐ 17ˢ
Decl. = + 28° 13′

1901.203	136°4	54″97
.225	136.4	54.43
1901.21	136.4	54.70

The only measures are:

1783.65	135°7	47″77	1*n*	H
1880.40	136.4	54.88	3*n*	β

The Weisse meridian positions give 132°9 : 54″10 (1825). Bigourdan has measured another pair, or the distance is erroneous.

H 857. W¹ XVIII. 192. 8 . . . 11

R.A. = 18ʰ 10ᵐ 53ˢ
Decl. = − 7 20′

1901.452	20°3	21″49
.509	19.6	20.92
1901.48	20.0	21.20

No other measures. H estimated 20° : 15″ (1820).

H 5494. B.A.C. 6213. 6 . . . 11.8

R.A. = 18h 13m 20s
Decl. = + 7° 12′

1901.116	69°.5	39″.07
.509	70.0	39.79
.512	70.0	39.60
1901.48	69.8	39.49

Only the estimates of H, 65° : 45″ : 5 . . . 15 (1827.6).

O. Stone

R.A. = 18h 16m :
Decl. = − 18° 55′

Given in Cin⁶ with this place, 81°.6 : 6″.72 : 8.5 . . . 9.0 (1879.30). No such pair in or near this place. A plenty of faint pairs of one kind and another, but nothing answering this description (1901.452). The place is certainly erroneous.

Σ 2311

R.A. = 18h 16m 38s
Decl. = + 11° 23′

1900.512	158°.8	5″.65
.515	159.1	5.72
1900.51	159.0	5.68

The motion appears to be rectilinear.

1830.30	170°.7	8″.65	4*n*	Σ

These positions give for the proper motion of A 0″.047 in 191°.2.

H 5496. L 34031

R.A. = 18h 20m 40s
Decl. = − 8° 7′

Given in H as 6m star, "suspected double with 180." I could not see any companion with the 6-in. in 1876, nor with the 40-in., 1901.455.

H N. 125. L 34018. 8.0 . . . 8.1

R.A. = 18h 21m 33s
Decl. = − 25° 7′

1901.551	281°.3	2″.67
.617	282.2	2.75
1900.60	281.7	2.71

No measures by H; given as Class I. The following are all the measures; distances discordant:

1889.77	99°.0	1″.62	1*n*	Ho
1897.70	101.8	3.11	2*n*	See

Σ 2332 *rej.* 9.2 . . . 11.2

R.A. = 18h 24m 42s
Decl. = + 64° 50′

1901.433	262°.5	10″.71
.436	263.7	11.89
.452	262.3	10.93
1901.44	262.8	11.18

No other measures. Not in D.M., but near D.M. (64°)1267, the place of which is given here.

Schjellerup. D.M.(7°)3741. 8.9 . . . 9.0

R.A. = 18h 27m 49s
Decl. = + 7° 21′

1901.509	197°.7	46″.02
.512	197.6	45.64
1901.51	197.6	45.83

From list of new pairs in A.N. 1485, the distance given 34″. No other measures. Both stars in D.M. There is a 13.5m star from A, 119° : 14″.5.

Σ 2340

R.A. = 18h 28m 30s
Decl. = + 31° 30′

1901.433	103°.9	23″.02
.436	103.3	23.20
.452	103.7	23.06
1901.44	103.6	23.09

The change appears to be due to a small proper motion of one of the stars.

1830.43	101°.6	21″.51	3*n*	Σ

OΣ 356 *rej.* L 34175

R.A. = 18h 29m 20s
Decl. = + 40° 4′

1900.473	305°.9	36″.11
1901.225	306.2	35.98
1900.85	306.0	36.04

Distance slowly decreasing from proper motion. Other recent measures by Hussey.

Σ 2345

R.A. = 18h 30m 23s
Decl. = + 20° 59′

1901.436	203°.8	8″.58
.452	204.0	8.53
1901.44	203.9	8.55

Rectilinear motion. Σ found 185°.1 : 7″.38 (1832.25) 4*n*.

Σ 2346

R.A. = 18h 31m 27s
Decl. = + 7° 26′

1901.471	291°8	21″17
.586	291.2	21.19
1901.53	291.5	21.18

The motion is rectilinear, distance and angle increasing.

1829.64	282°9	15″41	4*n*	Σ

These measures give for the proper motion of A 0″091 in 132°5.

Σ 2353 *rej.* D.M.(58°)1823. 8.5 . . . 11

R.A. = 18h 31m 36s
Decl. = + 58° 41′

1901.299	258°5	13″98
.318	258.8	13.76
1901.31	258.6	13.87

The only measures of this are found in the introduction to *Mens. Microm.*, 258°7 : 13″2 (1832.8). D.M.(58°)1824, which is 4′4*s*, is a similar pair with a little less distance.

O.Arg.S.18506. 8 . . . 8.4 . . . 10.3

R.A. = 18h 32m 28s
Decl. = − 25° 37′

A and B

1901.529	216°9	7″36
1902.449	217.1	7.22
1901.98	217.0	7.29

A and C

1901.529	285°7	53″27
1902.449	286.3	52.97
1901.98	286.0	53.12

A and D

1901.529	217°4	80″78
1902.449	217.9	80.14
1901.98	217.6	80.46

Noted "duplex" in O.Arg.S. and "triple" in Washington Transit Zones. The first measures from Washington Observations, 1862, do not agree with the present positions:

1862.8	212°8	7″47
1862.8	285.2	68.66
1862.8	218.5	79.02

H IV. 59 = Σ 2354 *rej.* 8.5 . . . 9.0

R.A. = 18h 32m 45s
Decl. = + 38° 38′

1900.473	302°1	29″52
1901.225	302.7	29.40
1900.85	302.4	29.46

Near *Vega*. The only other measures are:

1783.81	303°9	22″33	1*n*	H
1880.42	303.6	29.80	2*n*	β

Σ 2350 *rej.* L 34569. 6.7 . . . 11

R.A. = 18h 33m 30s
Decl. = − 7° 54′

1901.395	196°4	22″16
.452	196.1	22.18
1901.42	196.2	22.17

The only measures are:

1848.64	194°8	24″54	1*n*	Mitchell
1880.02	196.8	23.27	2*n*	β

Σ 2365 *rej.* 8.3 . . . 10.0

R.A. = 18h 34m 21s
Decl. = + 63° 36′

1901.433	26°1	19″58
.436	24.5	19.84
1901.43	25.3	19.70

No other measures. The principal star has a proper motion of 0″282 in 193°2 (Porter). The movement in A.G. is 0″306 in 189°3. This is D.M. (63°)1439 (= Groombridge 2630).

H 1336. 8.2 . . . 11.5 . . . 11

R.A. = 18h 35m 52s
Decl. = + 30° 11′

A and B

1901.263	87°4	17″59
.302	86.7	17.62
1901.28	87.0	17.60

A and C

1901.302	176°7	32″25

The only other observation is by H, 89°0 : 8″±; 300°± : 15″± (1828). There is another 11m star, 295°9 : 32″6. Σ 2367 is 47s*f*.

Ho 437

R.A. = 18h 35m 58s
Decl. = + 31° 32′

AB and C

1901.436	272°1	39″61
.452	273.2	40.02
1901.44	272.6	39.81

C and D

1901.436	335°8	3″08
.452	336.5	3.48
1901.44	336.1	3.28

Seeing too poor for AB.

H 1337. D.M.(31°)3330. 9.0 . . . 11.6

R.A. = 18h 36m 22s
Decl. = + 31° 28′

1901.436	162°4	9″08
.452	162.5	9.00
1901.44	162.4	9.04

Observations of H only:

1828+	174°9	6″ ±	1n

D.M.(45°)2667. 8.9 . . . 12.5 . . . 9.9.

R.A. = 18h 41m 42s
Decl. = + 45° 43′

A and B

1901.263	132°4	2″66
.299	131.7	3.15
.302	132.0	3.02
1901.29	132.0	2.94

A and C (= H 1346)

1901.263	216°8	24″38
.299	216.1	24.28
.302	216.4	24.45
1901.29	216.4	24.37

B is not in H, and was first noted by Espin (A.N. 3717), who found 135°9 : 2″73 (1900.62) 2n.

H VI. 50. 6.1 . . . 12.5 . . . 8

R.A. = 18h 43m 15s
Decl. = − 6° 3′

A and B

1901.397	359°4	22″83
.452	360.3	23.30
.471	361.2	23.49
1901.44	360.3	23.21

A and C

1901.397	170.6	113″75
.452	171.0	113.53
.471	170.7	113.98
1901.44	170.8	113.75

The small star B was first noted with the 6-in. The only measures are:

1879.37	356°8	22″53	1n	β
1879.35	170.5	113.98	2n	β

A and C are S.D.(6°)4922 and 4923.

H 1353. D.M.(11°)3651. 9.0 . . . 9.6

R.A. = 18h 48m 42s
Decl. = + 11° 9′

1901.359	208°0	8″41
.397	206.6	8.26
1901.38	207.3	8.33

The only measures are:

1828+	212°2	5″ ±	1n	H
1879.45	208.1	8.41	2n	Cin

Howe (Cin⁰) has a close pair in this place, 209°1 : 0″94 (1879.31) 1n. There is no close double here, and it is undoubtedly an error in reading or printing the distance.

Lewis

R.A. = 18h 50m
Decl. = + 34° 30′

This pair has the above place for 1900 (*Mon. Not.*, LX, 510) with the following measure:

1899.44	81°6	5″13	8.0 . . . 10.0	1n

The place is substantially identical with that of the 7.9m star, D.M.(34°)3316. This star was examined on two nights, and the stars in the vicinity as well, but no pair found to answer the description.

β 647

R.A. = 18h 50m 29s
Decl. = + 13° 27′

A and B

1900.512	16°1	1″07
.515	14.6	0.87
1900.51	15.3	0.97

A and C

1900.512	217°3	19″01
.515	217.6	19.03
1900.51	217.4	19.02

Change in the distance of C is confirmed by these measures.

β 648

R.A. = 18h 52m 30s
Decl. = + 32° 45′

1900.173	215°3	1″24
.553	225.6	1.40
.703	229.9	1.37
1901.203	218.3	1.07
1900.73	222.3	1.27

H 1357. D.M.(45°)2799. 8.0 . . . 10.5

R.A. = $18^h 53^m 34^s$
Decl. = + 45° 42′

1901.433	213°.2	26″.75
.452	211.9	26.92
1901.44	212.5	26.83

The only prior measures are:

1828+	210°.8	16″ ±	1*n*	H

Σ 2427

R.A. = $18^h 53^m 57^s$
Decl. = + 38° 4′

A and B

1900.473	61°.3	48″.54
1901.225	61.8	48.55
1900.85	61.5	48.54

B and C

1900.473	79°.3	7″.04
1901.225	78.9	7.32
1900.85	79.1	7.18

No change in BC, but the distance of AB is increasing. A comparison of these measures with Σ's gives for the proper motion of A 0″.064 in the direction of 41°.

A.G.C. 9. γ *Lyrae*

R.A. = $18^h 54^m 27^s$
Decl. = + 32° 31′

1900.515	298°.9	12″.87
.551	299.9	12.91
1901.210	300.1	12.69
1900.76	299.6	12.82

H 874. 7.1 . . . 13.3 . . . 11.7

R.A. = $18^h 54^m 35^s$
Decl. = − 0° 37′

A and C

1901.395	304°.2	23″.01
.397	304.6	22.92
.455	303.9	22.94
1901.41	304.2	22.96

A and B (new)

1901.395	2°.4	9″.30
.397	0.4	10.05
.455	359.0	9.74
1901.41	0.6	9.70

No other measures. H estimated 305° : 15″. The principal star is W¹ XVIII. 1351.

H 2852. D.M.(7°)3943. 9.1 . . . 9.9

R.A. = $18^h 57^m 16^s$
Decl. = + 7 14′

1901.512	131°.2	22″.63
.586	131.4	22.41
1901.55	131.3	22.52

H called the components *red* : *blue-green* ; 134°.5 : 18″ ± : 10 . . . 12 (1830).

Σ 2442

R.A. = $18^h 58^m 20^s$
Decl. = + 16° 48′

1901.299	207°.5	18″.37
.703	205.4	18.20
1901.50	206.4	18.28

The distance is decreasing, with no sensible change in the angle. These measures with those of Σ indicate an annual movement of A of 0″.06 in the direction of the smaller star. In the course of some three hundred years these stars will make a close pair.

H̦ V. 33. 15 *Aquilae*. 6 . . . 8

R.A. = $18^h 58^m 38^s$
Decl. = − 4° 13′

1900.458	208°.4	37″.05
.473	208.2	37.42
1900.46	208.3	37.23

The proper motion of A is very small, 0″.014 in 300°.3. The distance of H̦ in 1781 of 33″.88 is certainly too small.

H 5507. 6 . . . 12.2

R.A. = $18^h 58^m 49^s$
Decl. = − 15 50′

1900.458	63°.0	47″.10
1901.397	63.3	46.76
1900.92	63.1	46.93

H only estimated the angle 50° (1823.6). There is a 14m star about the same distance in 94°.8.

H 1364. D.M.(44°)3051. 9.4 . . . 9.4

R.A. = $18^h 59^m 36^s$
Decl. = + 44° 17′

1901.452	204°.7	3″.13
1902.433	207.7	2.98
1901.94	206.2	3.05

Described by H, "a most elegant double star; chief of a small cluster." The only observations are:

1828+	204°5	1″±	1n	H
1881.45	206.9	3.26	3n	β

H 1365. D.M.(26°)3413. 9.5 . . . 11

R.A. = 19h 0m 22s
Decl. = +26° 57′

1901.452	326°6	20″67
1902.219	325.1	20.04
1901.83	325.8	20.35

H has 327°5 : 15″± (1828), and calls the colors *ruddy : green.*

H V. 103. L 35845. 8.0 . . . 8.3

R.A. = 19h 1m 42s
Decl. = +35° 42′

1901.225	55°3	55″66
.299	55.5	55.62
1901.26	55.4	55.64

The only measures are:

1783.63	60°6	45″53	1n	H
1840.83	55.6	54.58	1n	OΣ
1866.68	55.5	55.08	1n	OΣ

Σ 2463. D.M.(45°)2831

R.A. = 19h 2m 30s
Decl. = +45° 38′

A and B

1901.529	5°1	9″44
.605	5.7	9.49
1901.57	5.4	9.46

A and C

1901.529	283°0	23″52
.605	282.4	23.96
1901.57	282.7	23.74

C not in Σ; first noted by H, who gave the angle 279°9 and 286°4 (1828). No other measures of this.

Σ 2477 *rej.* 8.5 . . . 10.5

R.A. = 19h 6m 2s
Decl. = −4° 40′

1901.452	47°4	28″08
.455	46.3	27.87
.471	45.9	27.92
1901.46	46.5	27.96

The only prior measures are:

1848.65	45°3	30″10	1n	Mitchell

H 1374. L 36113. 8.0 . . . 11.7 . . . 13.5

R.A. = 19h 6m 34s
Decl. = +44° 22′

A and B

1901.263	115°1	14″28
.318	114.3	14.41
1901.29	114.7	14.34

A and C

1901.263	5°9	31″34

The description in H is 110°3 : 8″±; 350°±: 15″±.

Schjellerup. 8.5 . . . 8.8

R.A. = 19h 6m 40s
Decl. = −3° 45′

1901.452	230°4	61″16
.455	230.2	61.02
1901.45	230.3	61.09

From list of double stars in A.N. 1485. The estimated distance is given 48″. The components are S.D.(3°)4513 and 4511.

Madler 7 = Ho 446

R.A. = 19h 7m 43s
Decl. = +21° 23′

A and B (new)

1901.433	292°1	2″79
.473	288.6	2.56
.512	291.0	2.82
1901.47	290.7	2.72

A and C

1901.416	50°0	5″01
.433	50.6	5.01
.473	45.2	5.21
.512	48.8	5.17
1901.46	48.6	5.10

B is new, but previously seen by Aitken. The measures of AC are:

1843.63	58°3	8″69	1n	Ma
1893.67	45.4	5.69	3n	Ho

The principal star is W² XIX. 193.

H 2858. 9.2 . . . 12.2

R.A. = 19h 8m 46s
Decl. = +22° 38′

1901.436	257°4	18″99
1902.219	257.9	19.06
1901.82	257.6	19.02

H gives 257°6 : 6″± (1830).

H 2859. 9.2 . . . 13

R.A. = 19ʰ 8ᵐ 47ˢ
Decl. = + 22° 40′

1901.436	28°.3	10″.87
1902.219	28.8	11.53
1901.82	28.5	11.20

H gives 19°.0 : 4″ ± (1830). The relation of H 2858 and 2859 is 10°.2 : 132″.70 (1901.43).

H 1377. L 36224. 7.0 . . . 12.9

R.A. = 19ʰ 8ᵐ 51ˢ
Decl. = + 47° 10′

1901.436	356°.5	36″.33
.605	357.1	36.35
1901.52	356.8	36.34

The only other observation is by H, 357°.0 : 30″ ± 7 . . . 16 (1828).

H 5101. 8.5 . . . 9

R.A. = 19ʰ 9ᵐ 2ˢ
Decl. = − 25° 33′

1901.586	306°.3	21″.32
.720	306.9	20.97
1901.65	306.6	21.14

Both components in Cord.D.M. as Nos. 13881 and 13879. H found 311°.5 : 20″ ± (1837.2).

H 1376. 8.0 . . . 11.2

R.A. = 19ʰ 9ᵐ 4ˢ
Decl. = + 15° 10′

1901.416	121°.6	10″.16
.471	123.6	10.14
1901.44	122.6	10.15

H gives 120°.4 : 6″ ± (1828).

OΣ 366 *rej.* 7.5 . . . 9.2

R.A. = 19ʰ 9ᵐ 48ˢ
Decl. = + 34° 0′

1901.471	230°.2	22″.14
.589	229.6	21.74
1901.53	229.9	21.94

Without change. The principal star is L 36242. Two faint stars *s* and *sf*.

OΣ (*App*) **178.** 6 . . . 7.5

R.A. = 19ʰ 9ᵐ 52ˢ
Decl. = + 14° 53′

1900.684	267°.8	89″.91
.687	267.4	89.83
1900.68	267.6	89.87

The following are all the other measures :

1856.60	86°.7	80″.84	1*n*	Se
1875.61	267.8	89.65	4*n*	Δ

The change is not confirmed. The distance of Secchi is an error or misprint. The A.G. positions give 268°.0 : 89″.68. The components are L 36207 and 36203.

H 2862. 1 *Vulpeculae*

R.A. = 19ʰ 11ᵐ 3ˢ
Decl. = + 21 11′

1901.416	13°.2	38″.86
.512	12.6	39.16
.586	12.8	39.08
1901.50	12.9	39.07

The only other measure is by H :

1830+	10°.6	25″ ± : 5-6 . . . 17

There is a 13m star, 158°.2 : 43″.5.

H 2863. B.A.C. 6590. 6.2 . . . 11.7

R.A. = 19ʰ 12ᵐ 10ˢ
Decl. = − 15 44′

1900.458	16°.0	45″.96
.551	16.6	45.67
1900.50	16.3	45.81

H gives 14°.6 : 15″ ± 6 . . . 15 (1830); "a third *np* very strongly suspected." I could not see any third star with the 6-in. in 1874, and the 40-in. shows nothing now. The principal star has a proper motion of 0″.293 in 204°.7.

H 266. 10.2 . . . 10.6

R.A. = 19ʰ 13ᵐ 8ˢ
Decl. = − 1 47′

1901.529	266°.2	14″.57
.586	265.1	14.55
1901.56	265.6	14.56

This is not in the D.M., but is closely *f* D.M.(−1°) 3706. H has 265° ± : 5″ ± (1820); "a suspected stel-

lar nebula in the field." The 40-in. shows this as a double nebula, with the appearance of belonging to the planetary class. It was rediscovered by Marth, and is No. 6778 of Dreyer.

Σ 2494 *rej.* 7.4 . . . 9.5

R.A. = 19h 13m 36s
Decl. = − 6° 51'

1900.458	81°1	25″26
1901.703	81.2	25.33
1901.08	81.1	25.29

There is an error of 180° in the angle of the only other measure:

1848.65	256°2	26″59	1*n*	Mitchell

Σ 2500 *rej.* D.M.(19°)3976. 8.0 . . . 10.5

R.A. = 19h 14m 11s
Decl. = + 19° 30'

1901.416	24°3	19″74
.586	23.2	20.06
1901.50	23.7	19.90

No other measures except angle by H, 23°0 (1830). The A.G. proper motion of A. is 0″062 in 280°2.

The 6.8m star, distant about 10′ *sp*, D.M.(19°)3975, is said to be an Algol variable, the magnitude descending to 9m, with a period of about 17 days (A.N. 3748).

OΣ (*App*) **180.** L 36460. 7.7 . . . 8.0

R.A. = 19h 15m 11s
Decl. = + 14° 12'

1900.684	266°5	80″40
.687	266.3	80.20
1900.68	266.4	80.30

The only measures are:

1874.98	266°3	80″22	3*n*	ɹ

H 884. 7.5 . . . 10.9 . . . 11.0

R.A. = 19h 15m 28s
Decl. = + 9° 36'

A and B

1901.471	299°2	45″05
.586	299.7	44.59
1901.53	299.4	44.82

B and C

1901.471	236°7	10″48
.586	239.2	10.46
1901.53	237.9	10.47

No other measures. The principal star is D.M. (9°)4075.

Σ 2501

R.A. = 19h 15m 42s
Decl. = − 4° 58'

1901.452	22°4	19″82
.455	21.7	20.05
1901.45	22.0	19.93

Without change. There is a 13.5m star from A. 108°3 : 9″6.

Σ 2506 *rej.* 8.7 . . . 9.1

R.A. = 19h 16m 14s
Decl. = + 14° 8'

1901.589	350°5	16″63
.720	351.2	16.60
1901.65	350.8	16.61

Rejected by Σ as not subsequently found. Evidently fixed. A is D.M.(14°)3888. The only measures are:

1843.60	170°9	16″33	1*n*	Ma
1875.01	351.3	16.43	2*n*	ɹ

Glasenapp. S.D.(14°)5425. 9.0 . . . 9.5

R.A. = 19h 18m 2s
Decl. = − 14° 52'

1901.605	68°1	24″33
1902.449	66.7	24.28
1902.03	67.4	24.30

The only other measures are:

1890.54	69°2	23″99	2*n*	Glasenapp

Schjellerup. 8.2 . . . 9.2

R.A. = 19h 19m 33s
Decl. = + 4° 36'

1901.589	214°0	41″24
.720	214.2	41.18
1901.65	214.1	41.21

From list of new pairs in A.N. 1485. No other measures. A is D.M.(4°)4096.

Σ 2517 *rej.* D.M.(22°)3687. 8.7 . . . 9.7

R.A. = 19ʰ 19ᵐ 40ˢ
Decl. = + 22° 32′

1901.589	138°.6	15″.85
.760	138.5	15.88
1901.67	138.5	15.86

No other measures.

O. Stone

R.A. = 19ʰ 20ᵐ :
Decl. = − 16° 11′

Given in Cin[5], 195°.4 : 4″.84 : 6.8 . . . 7.3 (1880.62) 1*n*. I could not find any such pair in or near this place. There is no bright star here in the S.D.

H 2871. 4 *Vulpeculae*. 6 . . . 11.0

R.A. = 19ʰ 20ᵐ 12ˢ
Decl. = + 19° 34′

1901.473	106°.5	24″.89
.512	106.3	24.89
1901.49	106.4	24.89

H gives 110°.4 : 30″± (1830); "two more near; one extraordinarily faint." There is a star of about the same magnitude in 197°.9 at about double the distance, and a 13.5m star, more distant, in 231°.4.

ν *Aquilae*

R.A. = 19ʰ 20ᵐ 23ˢ
Decl. = + 0° 6′

1901.416	287°.9	200″.50
.433	288.2	200.74
1901.42	288.0	200.62

Measured in looking for H̦ IV. 34, which is about 3ᵐ*f*. B is D.M.(0°)4204. The proper motion of A is 0″.024 in 359.7 The A.G. positions give 288°.6 : 201″.4. Many small stars nearer A than this.

3 *Cygni*. 6.5 . . . 10.4

R.A. = 19ʰ 20ᵐ 28ˢ
Decl. = + 24° 32′

1900.515	78°.3	30″.94
.553	76.9	30.47
1901.473	76.2	30.21
1900.85	77.1	30.54

The principal star has a large proper motion, 0″.658 in 198°.1 (Berlin A.G.). The only other measures are by OΣ, the first of which is:

1866.72	122°.8	27″.91	1*n*	OΣ

H̦ N. 119. 6 . . . 8.2

R.A. = 19ʰ 22ᵐ 27ˢ
Decl. = − 27° 14′

1901.455	141°.9	7″.65
.509	141.3	7.87
1901.48	141.6	7.76

No measures in H̦. There is an error of about 23′ in his Decl. The measures of this show no change. It was measured by me in looking for No. 153 of the Harvard list, which has an error of about 3ᵐ R.A. and 10′ in Decl. It is identical with the H̦ pair.

H 887. L 36791. 7.0 . . 13.2

R.A. = 19ʰ 22ᵐ 54ˢ
Decl. = − 7° 17′

1900.473	348°.7	35″.54
.476	348.7	35.08
1900.47	348.7	35.31

No other measures. H called the small star 20m. The principal star appears to be the variable U *Aquilae*.

H̦ IV. 33. 9.5 . . . 9.7

R.A. = 19ʰ 23ᵐ 9ˢ
Decl. = 0° 0′

1901.433	335°.7	12″.96
.512	335.7	13.12
1901.47	335.7	13.04

H̦ describes this as "the first of 2 stars *p* ν *Aquilae*; distance of the two nearest 21″.98, inaccurate." After a very careful examination, I am certain that the star which he calls ν *Aquilae* is really the 6.9m star, D.M.(−0°)3760, which follows the other 2ᵐ 47ˢ. The description then applies perfectly This faint pair is not in the D.M. The place given above is that of the bright star.

OΣ (*App*) **182.** 6.9 . . . 7.4

R.A. = 19ʰ 23ᵐ 37ˢ
Decl. = + 49° 54′

1901.471	305°.6	72″.03
.509	305.4	71.67
.529	305.8	71.69
1901.50	305.6	71.80

The only other measures are:

1874.62	307°.3	71″.79	3*n*	Δ

There is a 14m star from A 113°9 : 12″17 (1901.53) 1*n*. There is also a small nebula in the field; from A in the direction of 217°3, and from B in 221°0. The principal star is given a proper motion of 0″085 in 51°3.

⅃ 20. 7 . . . 10.1 . . . 9.7

R.A. 19h 25m 1s }
Decl. − 2° 22′ }

A and B

1901.589	65°2	1″48
.760	68.9	1.22
1901.67	67.0	1.35

A and C (= Σ 2535)

1901.589	298°7	25″98
.601	297.9	25.91
.760	298.7	25.90
1901.65	298.4	25.91

No material change.

H 5128. 8.1 . . . 10.1 . . . 10.3

R.A. 19h 26m 36s }
Decl. − 18° 52′ }

A and B

1901.589	111°0	20″88
.601	111.4	21.08
1901.59	111.2	20.98

B and C

1901.589	125.5	4″29
.601	127.1	4.17
1901.59	126.3	1.23

No other measures of BC except an angle by H of 125°9 (1836.5). The single measure of AB of 1879 in Cin³ shows no change. A and B are S.D.(18°) 5113 and 5111.

Howe. 8.8 . . . 10.7 . . . 10.1

R.A. 19h 29m 36s }
Decl. + 3° 12′ }

A and B

1901.589	23.3	6″75
.742	25.6	6.81
1901.66	24.4	6.78

A and C

1901.589	306°7	32″50
.742	305.6	32.29
1901.66	306.1	32.39

Discovered by Howe, but the place in Cin³ is in error in both R.A. and Decl. The only measures are those by him in 1879, which show no motion. The principal star in D.M.(3°)4079.

H V. 104. 7.3 . . . 9.8

R.A. 19h 30m 55s }
Decl. + 15° 37′ }

1901.433	126°6	39″08
.436	126.3	38.56
.471	125.4	38.82
1901.45	126.1	38.82

The place is a little uncertain in H. The principal star is D.M.(15°)3877. The magnitude in D.M. is 6.7. The only other measures, except position angle of 106°3 (1783.65), are:

1893.55	121°9	39″27	1*n*	Bigourdan

ε *Sagittae*

R.A. 19h 31m 51s }
Decl. + 16° 12′ }

1901.433	81.9	89″78
.471	81.3	89.71
.473	80.9	89.96
1901.46	81.4	89.82

As a wide pair this is H VI. 26 = H VI. 63 = H N. 83 = S 721 = OΣ (*App*) 185. In H VI. 63 the angle is reversed. H N. 83 is given 3m*p* and 11 *s*, but it is identical with this star. The A.G. proper motion of A is very small, 0″013 in 297°5.

1782.30	81.5	91″87	1*n*	H
1800	79.9	87.86		Lalande
1870.2	81.4	91.57		A.G.
1875.61	81.3	90.68	4*n*	⅃

H 1423. 9 *Cygni*. 6.5 . . . 11.2

R.A. 19h 32m 22s }
Decl. + 29° 5′ }

1900.473	127°8	20″85
.687	129.4	21.15
1900.58	128.6	21.00

Only H, 136.3 : 12 ± (1828). The proper motion is insensible, 0″021 in 158°5 (Auwers).

OΣ 379 *rej.* 8.0 ... 8.5

R.A. 19h 33m 55s
Decl. +33° 38′

1900.703	86°.1	21″.97
1901.260	86.7	21.89
1900.98	86.5	21.93

Without change.

β H. 32 β N. 84. 6.5 ... 8.6

R.A. 19h 34m 0s
Decl. +16° 18′

1900.173	300.9	28″.16
.553	301.8	28.57
1900.51	301.3	28.51

The only measures are:

1796.59	301°.8	27″.20	1*n*	β
1840.22	302.2	28.61	2*n*	OΣ

H 2888. 15 *Aquilae.* 6.5 ... 13.7

R.A. 19h 34m 33s
Decl. 0° 51′

1900.176	354°.2	12″.89
.545	355.4	12.23
1900.49	354.8	12.56

No observations except H, 354.5 : 30″ : 7 ... 19 (1830). His description is: "A large star in a constellation of at least a dozen small ones within 2′ distance; that taken forms with the large star a good representation of the *Georgium Sidus* and one of its satellites. It is a fair comparison in point of light."

O. Stone

R.A. 19h 35m
Decl. +37° 55′

The measures in Cin' are 221.1 : 5″.06 : 9.5 ... 11.0 (1879.61) 1*n*. I could not find anything in this vicinity to correspond with the description, though there are many faint pairs. One near this place is 64°.7 : 7″.51.

Σ 2560 *rej.* L 37106. 7.2 ... 9.5

R.A. 19h 35m 31s
Decl. +23° 26′

1901.605	295.0	15″.12
.760	295.1	15.18
1901.68	295.0	15.30

No other measures.

H 895. 8.7 ... 10.5 ... 9.1

R.A. 19h 36m 16s
Decl. +0° 58′

A and B

1901.133	209.0	11″.17
.173	205.8	13.99
.512	208.3	11.39
1901.47	207.7	11.18

A and C

1901.133	17°.5	28″.50
.173	16.1	28.65
.512	16.6	28.43
1901.47	16.8	28.53

C and D (new). C 13.7

1901.133	125°.1	1″.66
.512	123.3	1.52
1901.47	124.2	1.59

No measures by H. He saw only the three brighter stars. A and C are D.M.(0°)1283 and 1284.

OΣ 381 *rej.* 7.2 ... 11.7

R.A. 19h 37m 23s
Decl. +3° 53′

1900.176	5.7	15″.01
.545	6.5	15.16
.554	5.7	15.20
1900.51	6.0	15.13

Unchanged.

W¹ XIX. 944

R.A. 19h 37m 56s
Decl. +1° 28′

Noted "duplex" in Weisse. It is not double, although there are several stars in the field. The 7¼*m* star *nf* has a 25″ companion *p*. In the D.M. the Weisse star is (1°)1205 and a 9.3*m* star, No. 1208, is 26.5*f* and 2′.2*n*. The difference in R.A. is now much less.

OΣ (*App*) 190 7.2 ... 12 ... 8.1

R.A. 19h 39m 50s
Decl. +16° 57′

A and B

1901.471	299.1	11″.82
.509	298.8	11.66
1901.49	299.1	11.74

A and C

1901.471	316°2	67″51
.509	316.3	67.56
1901.49	316.2	67.53

The faint star was added with the 18½-in. No change.

1878.40	300°2	11″64	1n	β
1875.66	316.5	67.66	3n	Δ

H̥ N. 113

R.A. = 19h 40m
Decl. = + 37° 15′

H̥ has no measures; it is given as Class II, with the above place. There is no double star here, and there is little doubt of his observation belonging to Σ 2578, which is in the same vicinity *nf.* In the course of this search I ran on to OΣ 384, and measured it once; 192°7 : 0″98 (1901.47).

H 898

R.A. = 19h 41m 55s
Decl. = + 31° 24′

Described by H as a faint triple, all 11m, 225° ± : 2″ ± AB; 225° ± : 6″ ± AC. Very carefully looked for twice, but nothing of this kind found. There are many faint pairs in the vicinity, but not of the description given.

Ho 114

R.A. = 19h 41m 59s
Decl. = + 32° 36′

A and B. 7.2 . . . 13.5

1901.529	233°7	3″15

A and C (new). C = 11

1901.529	215°4	9″72

A and D. D = 8.2

1901.471	200°2	31″36
.509	200.1	31.49
.529	200.7	31.47
1901.50	200.4	31.44

AD is H̥ N. 110 = S 726 = OΣ (*App*) 192. The faint star C has not been seen before. There is no material change in the other stars.

Σ 2581 *rej.* 8.0 . . . 9.6

R.A. = 19h 43m 8s
Decl. = − 11° 42′

1901.455	282°6	38″00
.473	282.7	38.35
.531	282.2	38.37
1901.48	282.5	38.24

The principal star is P XIX. 1058. The observation in Mitchell belongs to some other pair. The only measure is:

1879.54	281°3	37″88	3n	Cin

Jacob. 9.0 . . . 9.1

R.A. = 19h 43m 59s
Decl. = − 11° 5′

1901.455	320°0	28″66
.473	319.0	28.60
.531	319.0	29.00
1901.49	319.3	28.75

The components are S.D.(11°)5146 and 5147. The only other measures are:

1845.8	319°7	30″80	Jacob

Hussey in 1899 found A to be a close and unequal pair (= Hu 77). The seeing was too poor to measure AB. This triple is 12s*p* 51 *Aquilae.*

Ho 275. 51 *Aquilae.* 5 . . . 12.9

R.A. = 19h 44m 11s
Decl. = − 11° 4′

1901.531	117°5	20″83
.586	116.2	20.94
1901.56	116.8	20.88

The increase in the distance since the measures of Hough agrees with the proper motion of A, 0″08 in 315°5.

H 603. 19 *Cygni.* 6 . . . 9.8 . . . 11.7

R.A. = 19h 46m 19s
Decl. = + 38° 25′

A and B

1901.605	103°7	51″29
1902.133	103.9	51.16
1902.02	103.8	51.22

B and C

1901.605	12°0	21″60
1902.433	13.7	21.99
1902.02	12.8	21.79

Positions estimated by H; he calls C 18m. The large star has a proper motion of 0″112 in 3°6.

1887.81	102°1	53″92	2*n*	Engelhardt

H 900. 56 *Aquilae*. 6 . . . 11.5

R.A. = 19ʰ 47ᵐ 37ˢ
Decl. = − 8° 53′

1901.473	76°9	46″33
.531	77.9	46.55
1901.50	76.4	46.44

No measures in H. Unchanged since my measures in 1880.

Σ 2593 *rej.* 8.3 . . . 9.7 . . . 11.0

R.A. = 19ʰ 47ᵐ 37ˢ
Decl. = + 11° 32′

A and B

1901.436	236°2	12″34
.452	235.8	12.53
.529	235.6	12.27
1901.47	235.9	12.38

B and C (new)

1901.436	301°8	3″85
.452	307.4	3.52
.529	303.7	3.72
1901.47	304.3	3.70

No other measures, except Leipsic A.G., 237°0: 12″12 (1893.54). A is D.M.(11°)4030.

Wilson. Cord.D.M.(24°)15677. 9 . . . 10.4

R.A. = 19ʰ 47ᵐ 46ˢ
Decl. = − 24° 10′

1901.605	116°1	17″17
1902.433	116.5	17.32
1902.02	116.3	17.24

Identified as above. The only measure is:

1885.71	117°6	17″34	1*n*	H. C. Wilson

H III. 105 = Σ 2595 *rej.* 9.4 . . . 9.7

R.A. = 19ʰ 47ᵐ 55ˢ
Decl. = + 19 59′

1901.436	215°5	16″38
.589	214.2	16.34
1901.51	214.8	16.36

There is a 10m star 37°0 : 24″0. The other measures are:

1783.45	219°6	14″48	1*n*	H
1881.39	214.9	16.31	3*n*	β

Evidently fixed. A is D.M.(19°)4192.

OΣ 390.

R.A. = 19ʰ 50ᵐ 19ˢ
Decl. = + 29° 53′

A and B

1901.531	22°2	9″40

A and C

1901.531	175°5	16″15

Without change.

H 1458. 8.8 . . . 8.8

R.A. = 19ʰ 54ᵐ 22ˢ
Decl. = + 10 51

1901.436	132°5	16″52
.452	134.8	16.32
.529	133.3	16.06
1901.47	133.5	16.30

The components are D.M.(10°)4132 and 4133. The only complete measure is:

1875.11	133°7	16″04	2*n*	Δ

H I. 93. L 38205. 8.0 . . . 8.6

R.A. = 19ʰ 55ᵐ 30ˢ
Decl. = − 0° 32′

1900.458	293°0	2″14
1901.433	298.9	2.07
.436	299.7	2.14
.452	294.2	1.97
1901.19	296.4	2.08

The change, if any, is a small increase in the angle. There is a 11.5m star, 2°2 : 26″6.

Σ 2612

R.A. = 19h 55m 31s
Decl. = + 6° 36′

1901.452	53°.3	38″.97
.471	53.7	38.69
.529	53.6	39.05
1901.48	53.5	38.90

The distance is slowly increasing from proper motion, the angle remaining constant. Σ found 36″.59(1827.67). These stars point to a 3″ or 4″ pair of 12.5m stars about 30″ from B.

Harvard Zones. 8.6 . . . 13.0 . . . 11.5

R.A. = 19h 57m 6s
Decl. = + 0 22′

A and B

1900.458	145°.2	4″.39
1901.433	146.1	4.05
1900.94	145.6	4.22

A and C

1900.458	189°.7	16″.24
1901.433	190.5	16.90
1900.94	190.1	16.57

No other measures. The description in H.Z. is *sf* : 4″± : 8-9 . . . 15.

Σ 2619

R.A. = 19h 57m 29s
Decl. = + 47° 56′

A and B (= Σ 2619)

1901.320	242°.0	4″.31
1902.433	244.8	4.10
1901.87	243.4	4.20

A and C

1901.318	305°.0	17″.73
.320	303.8	17.35
1902.433	304.2	17.42
1901.69	304.3	17.50

C and D

1901.320	179°.5	5″.12
1902.433	181.8	5.98
1901.87	180.6	5.55

No change in AB. C and D are not in Σ. C was first noted by H, and D added by OΣ in 1854. The only measures of CD are:

1879.49 183°.8 5″.45 1*n* β

H 1470. D.M.(37°)3744. 7.0 . . . 9.1

R.A. = 19h 59m 19s
Decl. = + 37 59′

1901.605	337°.2	29″.18
1902.449	337.2	28.94
1902.02	337.2	29.06

This is H 605, the Decl. of which is uncertain in H. The companion is D.M.(37°)2743. The colors, red and green, are well marked. There is probably a misprint in the distance by Secchi, 335°.2 : 23″.83 (1856.63) 1*n*.

26 *Cygni*. 6 . . . 8.3 . . . 12.2

R.A. = 19h 57m 58s
Decl. = + 49 46′

A and B

1898.463	147°.4	41″.98
.518	147.1	41.87
.520	146.8	42.03
1898.50	147.1	41.96

B and C

1898.463	74°.7	8″.74
.520	75.0	9.30
1898.49	74.8	9.02

B and D (new). D = 13.7

1898.463	257°.2	10″.26
.520	257.9	9.94
1898.49	257.5	10.10

The bright stars make H V. 47 = H VI. 60 = OΣ (*App*) 197. C was added with the 18½-in. in 1878. So far no sensible change in AB.

H 2927. 7.5 . . . 12 . . . 13.2

R.A. = 19h 59m 13s
Decl. = + 0 7′

A and B

1901.433	125°.3	24″.14
.471	126.2	24.44
.512	123.5	24.43
1901.47	125.0	24.34

B and C (new)

1901.433	185°.7	4″.82
.471	186.2	4.91
.512	184.0	4.77
1901.47	185.3	4.84

No complete measures. H gives 135°.0 (1830).

OΣ 397 *rej.*=**H V. 105**. 7.3 . . . 8.5

R.A. = $19^h\,59^m\,16^s$
Decl. = $+15°\,33'$

1900.647	173.1	37″.70
.687	173.4	37.86
1900.66	173.2	37.78

Slow change from proper motion.

OΣ (*App*) **198**

R.A. = $20^h\,0^m\,17^s$
Decl. = $+\,7°\,13'$

A and B

1901.531	174°.0	37″.17
.742	173.9	37.41
1901.63	173.9	37.29

A and C

1901.531	186°.2	64″.91
.703	186.0	65.27
.742	186.0	65.11
1901.66	186.1	65.10

No other measures of B, which was first noted with the 18½-in. No change in AC since the measures of Δ.

H 1477. L 38450. 8.0 . . . 10.6

R.A. = $20^h\,0^m\,55^s$
Decl. = $+12°\,20'$

1901.531	271°.4	20″.16
.720	270.6	19.93
1901.62	271.0	20.04

Only H, 265°.0 : 12″ ± (1828).

H IV. 34. 9.0 . . . 9.4

R.A. = $20^h\,1^m\,26^s$
Decl. = $-\,0°\,57'$

1901.509	197°.8	47″.48
.512	198.1	47.58
1901.51	197.9	47.53

The correct place is given above. A is D.M.(−1°) 3896. No other measures. H estimated distance 30″.

H VI. 27. **θ** *Aquilae*. 3 . . . 13.0

R.A. = $20^h\,5^m\,7^s$
Decl. = $-\,1\;11'$

1901.512	260°.0	113″.95
.586	259.9	113.47
1901.55	260.0	113.71

Herschel's place is that of *θ Aquilae*: but in the original Catalogue (*Phil. Trans.* 1782) it is described "a star north of *θ*; distance about 1′," and it is not probable that the star measured above is the right one. Most likely it is the 8m star, L 38760, which is $2^m\,43^s f$ *θ* and 4′.1*s*. I have measured the components of this (7.1 . . . 8.5) as follows:

1901.512	80°.5	64″.09
.586	80.3	64.05
1901.55	80.4	64.07

This star has a proper motion of 0″.262 in 203°.6.

H VI. 92. 8.1 . . . 9.0

R.A. = $20^h\,5^m\,9^s$
Decl. = $-\,12°\,26'$

1900.512	265°.4	84″.96
.515	265.4	85.91
.551	265.3	85.00
1901.589	264.9	85.14
1900.79	265.2	85.25

The components are S.D.(12°)5663 and 5662. The only measures are:

1783.18	267°.9	62″.27	1*n*	H
1879.63	265.8	51.35	1*n*	Cin

An examination of Cin[5] shows that there is an error of 10 revolutions in reading one head, and that the observed distance was 85″.53 instead of 51″.35.

S 735 = **H V. 136**. 7.5 . . . 7.7

R.A. = $20^h\,5^m\,9^s$
Decl. = $-\,0\;29'$

1901.605	206°.3	55″.25
.703	206.1	55.48
1901.65	206.2	55.36

Only one measure since 1825, but apparently without change.

S 740 = **OΣ** (*App*) **202**. 7.3 . . . 7.4

R.A. = $20^h\,8^m\,18^s$
Decl. = $+\,6°\,14'$

1901.529	192°.8	42″.96
.703	193.0	43.36
.720	192.6	43.22
1901.65	192.8	43.18

A comparison with the measures of S and Δ shows that these stars are relatively fixed. They have a common proper motion of 0″.197 in 236°.1 (Bossert). The components are D.M.(6°)4480 and 4479.

D.M.(0°)4453. 9.0 . . . 10.5 . . . 10

R.A. = 20h 9m 15s
Decl. = + 0° 20′

A and B

1901.799	256°8	1″70
1902.471	258.9	1.88
1902.13	257.8	1.79

A and C

1901.799	270°6	31″48
1902.471	270.7	31.30
1902.13	270.6	31.39

Noted as double in the Harvard Zones. The only other measures are:

AB	1879.46	259°2	1″2±	1n	Cin
AC	1879.46	276.8	31.17	1n	Cin

σ *Capricorni*. Sh 380 = H V. 87

R.A. = 20h 12m 28s
Decl. = − 19° 30′

1901.605	178°0	55″90
.742	177.5	55.90
1901.67	177.7	55.90

No change since my measures in 1881.

ν *Capricorni*. . . . 11.0

R.A. = 20h 14m 0s
Decl. = − 13 8′

1901.605	210°8	54″14
.742	210.5	53.98
1901.67	210.6	54.06

The only measures are:

1836	28°0	56″33	1n	Lamont
1877.77	210.1	55.38	1n	β

H 2953. D.M.(8°)4408. 8.7 . . . 10.7

R.A. = 20h 15m 16s
Decl. = + 8° 14′

1900.706	260°2	25″19
1901.395	261.7	25.52
1901.05	260.9	25.35

Only observed by H, 260°4 : 18″± : 9 . . . 16 (1830); 'delicate and difficult."

H N. 138. S.D.(17°)5954. 8.0 . . . 8.6

R.A. = 20h 15m 23s
Decl. = − 17 9′

1901.455	331°2	3″07
.742	331.5	3.09
1901.60	331.3	3.08

No measures by H. Unchanged since my measures of 1878. The first mention of this pair after H is by Peters, who found it in observing an asteroid (A.N. 1635).

H. C. Wilson. 9.5 . . . 9.5

R.A. = 20h 17m 33s
Decl. = + 5 12′

1901.531	359°8	2″14
.720	360.2	2.05
1901.62	360.0	2.09

Discovered by Wilson. The correct place is given above. It is D.M.(5°)4496. The only measures are:

1893.39	359°7	1″80	3n	Wilson

S 749

R.A. = 20h 21m 14s
Decl. = − 2 30′

1901.608	189°8	60″00
.720	189.6	59.57
.742	189.6	59.85
1901.69	189.7	59.81

No change since my measures in 1880, and the measures of S agree with the last. Bossert gives the proper motion of A 0″161 in 248°2, and B 0″183 in 244°1. The measures show no relative motion.

β 363

R.A. = 20h 24m 28s
Decl. = + 20° 12′

A and B

1900.438	64°1	18″70
.703	65.2	18.74
.706	64.5	19.14
1900.61	64.6	18.86

A and C

1900.438	198°.4	44″.22
.703	199.0	44.58
1900.62	198.7	44.40

These measures indicate that the change in AB is due to the movement of the 11.5m star B, and not the 7m star A.

H N. 7. 10.0 . . . 10.5 . . . 10.3

R.A. = 20h 26m 31s : ⎫
Decl. = − 26° 9 : ⎭

1901.608	340°.7	14″.84	AB
.608	226.7	20.04	AC

Given by H Class I–II; "very close triple; vertex *f*." This is the only object I could find answering the description. The places are practically the same. There is a 13m star 150°.0 : 15″.3 from A.

Σ 2696

R.A. = 20h 27m 34s ⎫
Decl. = + 5° 2′ ⎭

A and B

1901.742	305°.7	0″.84
.760	307.3	0.70
1901.75	306.5	0.77

AB and C

1901.742	348°.5	13″.73
.760	349.0	13.83
1901.75	348.7	13.78

The 14m star, C, was noted by me with the 18½-in. some twenty years ago. No other measures of it. No material change in AB.

Σ 2697 *rej.* 7.5 . . . 9.5

R.A. = 20h 28m 13s ⎫
Decl. = − 0° 53′ ⎭

1901.720	1°.8	30″.25
.760	1.8	30.59
1901.74	1.8	30.42

The only other measure is:

1848.67	1°.7	32″.10	1*n*	Mitchell

Σ 2708

R.A. = 20h 34m 7s ⎫
Decl. = + 38° 13′ ⎭

A and C

1901.318	330°.0	27″.73
.320	329.9	27.59
1901.32	330.0	27.66

A and B

1901.320	20°.3	15″.39

The 13.5m star B was added by Hall with the 26-in. The principal star has a proper motion of 0″.242 in 138°.7, and it is well known that the change in C since Σ corresponds to this movement. The other companion was measured to see whether that showed the same displacement. From a comparison of my position with that of Hall in 1878 it appears that B is fixed in space like the other.

H IV. 78 = Σ 2712 *rej.* 8 . . . 11.9

R.A. = 20h 34m 25s ⎫
Decl. = + 62° 1′ ⎭

1901.608	124°.3	28″.92
.758	124.8	28.72
1901.68	124.5	28.82

The only observation is:

1783.22	49°.4	19″.53	1*n*	H

There is no star in this place. In the notation then in use this angle corresponds to 40°.6*nf*. If it is read *sf*, the angle would be 130°.6. The principal star is D.M.(61°)2039.

W² XX. 1168

R.A. = 20h 35m 1s ⎫
Decl. = + 37° 58′ ⎭

In Weisse, "duplex; comes ad boream." This star has no companion. The description applies to Σ 2708, which is near by.

H 2988. D.M.(2°)4227. 8.5 . . . 9.6

R.A. = 20h 35m 52s ⎫
Decl. = + 2° 32′ ⎭

1901.512	138°.9	24″.65
.529	138.3	24.65
1901.52	138.6	24.65

H says, "large star very red." It did not appear so on this occasion, nor when examined by me in 1876. 139°.7 : 20″± : (1830).

β 673

R.A. = 20h 36m 29s
Decl. = +20° 17′

A and B

1900.438	297°.8	3″.51
1901.799	296.6	3.83
1901.11	297.2	3.67

A and C

1900.438	165°.3	105″.8	Single dist.
1901.799	165.0	105.62	
1901.11	165.1	105.71	

OΣ 411. 7.8 . . . 10.9

R.A. = 20h 38m 17s
Decl. = +45° 24′

1901.531	314°.2	17″.03
.608	311.6	16.19
1901.57	312.9	16.61

Rectilinear motion.

H 2994. 17 *Capricorni.*

R.A. = 20h 39m 12s
Decl. = −21° 57′

Herschel gives 338°.7 : 20″± : 6 . . . 18 (1830); "requires verification." I examined this star several times with the 18½-in. in 1877 under favorable conditions without finding any companion; and on two nights was unsuccessful with the 40-in. It is safe to say the suspected companion has no existence.

Skinner. 8.8 . . . 8.8

R.A. = 20h 39m 46s
Decl. = −17 8′

1900.515	299°.8	3″.43
1901.471	297.9	3.66
.531	299.1	3.60
1901.17	298.9	3.56

From a list of doubles furnished me several years ago by Professor Skinner, of the Naval Observatory, noted by him in his meridian work. It has since been catalogued by Innes.

OΣ 412 *rej.* 7.3 . . . 10.9 . . . 10.9

R.A. = 20h 41m 1s
Decl. = +50 14′

A and B

1901.260	280°.3	25″.21
.318	281.5	25.32
.320	281.1	25.27
1901.30	281.0	25.27

B and C

1901.260	6°.0	4″.98
.318	9.3	4.83
.320	7.0	4.83
1901.30	7.4	4.88

At this time there were no measures of these stars published.

η *Cephei.* 3.5 . . . 11

R.A. = 20h 42m 51s
Decl. = +61° 22′

1900.684	38°.8	85″.18
.744	38.5	85.30
1900.71	38.6	85.24

The only previous measures are:

1879.35	33°.8	100″.54	2*n*	β

The large star has a proper motion of 0″.816 in 6°.7, and the computed place of the companion from this movement and the measures of 1879 is 39°.1 : 85″.61. The small star is therefore not moving with the other.

H 1381. 55 *Cygni.* 6 . . . 10.8

R.A. = 20h 44m 50s
Decl. = +45° 40′

1901.531	174°.0	20″.70
.608	173.8	20.74
1901.57	173.9	20.72

Without change.

1875.11	174°.0	20″.49	2*n*	Δ

H 3004. 10.9 . . . 10.9

R.A. = 20h 46m 15s
Decl. = +62 5′

1901.531	197°.7	3″.74
.758	197.8	3.88
1901.64	197.7	3.81

This is in the field *p* the 8m star, D.M.(61°)2057. The only observations are 193°.5 : 1½ : 13 = 13 (1830).

O.Arg.N. 21247. 8.7 . . . 8.8

R.A. = 20h 48m 2s
Decl. = +53 36′

1901.531	184°.3	9″.64
.608	183.5	9.53
1901.57	183.9	9.58

"Duplex" in O.Arg. No other measures. The components are *reddish : greenish.* Other companions more distant.

H 5514

R.A. = 20ʰ 49ᵐ 31ˢ
Decl. = − 5° 31′

Described by H, 200°± : 7″± AB; 70°± : 12″± AC, all small stars. There is a faint triple of 11m stars near this place, but the angles do not correspond. Glasenapp was unable to find it.

OΣ 421 *rej.* 8.0 . . . 9.3

R.A. = 20ʰ 50ᵐ 47ˢ
Decl. = + 31° 43′

1901.531	192°.6	36″.73

Hussey measures a 12.5 star, 77°.5 : 30″.57 (1898.58).

Howe. L 40496. 6.8 . . . 11

R.A. = 20ʰ 51ᵐ 2ˢ
Decl. = 0 0

1901.529	71°.7	26″.30
.531	72.0	26.25
1901.53	71.8	26.27

The other measures are:

1879.50	71°.8	26″.19	2*n*	Cin[5]

The principal star has a considerable proper motion, but the authorities differ as to the amount; 0″.109 in 204°.2 (Bossert); 0″.075 in 180° A.G. The stars seem to be moving together.

D.M.(0°)4621. 8.8 . . . 12.7 . . . 9.0

R.A. = 20ʰ 51ᵐ 21ˢ
Decl. = + 0° 8′

A and B

1901.529	335°.7	11″.44
.531	334.1	11.36
1901.53	334.9	11.40

A and C

1901.529	138°.6	41″.25
.531	138.7	41.38
1901.53	138.6	41.31

In the Harvard Zones, "double, comp. *f*." The only measure is:

1879.50	137°.4	41″.76	2*n*	Cin[5]

H 3006. D.M.(2°)4285. 9.7 . . . 9.7

R.A. = 20ʰ 54ᵐ 51ˢ
Decl. = + 2° 29′

1900.551	292°.9	1″.73
1901.455	289.8	1.53
.512	293.2	1.72
1901.17	292.0	1.66

The prior observations are:

1830	300°±	0″.5	1*n*	H
1878.17	291.0	1.81	2*n*	β

L 40682. 6 . . . 8.8

R.A. = 20ʰ 54ᵐ 58ˢ
Decl. = + 18° 52′

1901.531	333°.3	45″.92
.720	333.5	45.49
.739	333.4	45.63
1901.66	333.4	45.68

Both stars in D.M. The only measure is:

1880.63	332°.7	44″.66	2*n*	β

D.M.(0°)4644

R.A. = 20ʰ 56ᵐ 24ˢ
Decl. = + 0° 10′

Described in the Harvard Zones, *sp* : 3″± : 9 . . . 12. There is no companion of any kind, and nothing as described near this place.

H 1606. D.M.(53°)2533. 8.8 . . . 9.7

R.A. = 20ʰ 57ᵐ 5ˢ
Decl. = + 54° 4′

1901.531	186°.4	18″.33
.608	185.6	18.51
.739	185.9	18.34
1901.62	186.0	18.39

H gives 185°.1 : 12″± (1828). There is a fine nebula in the field.

H 1608. 7.4 . . . 10.7

R.A. = 20ʰ 59ᵐ 9ˢ
Decl. = + 11° 58′

1901.509	257°.9	19″.41
.586	257.3	19.73
1901.54	257.6	19.57

The measures at Cin in 1879 show no change. Many stars in the field.

H 274. 10.6 . . . 11.0

R.A. = 21ʰ 1ᵐ 20ˢ
Decl. = + 11° 24′

1901.586	91°.1	9″.46
.589	91.9	9.52
1901.58	91.5	9.49

Not in D.M., but closely *f* D.M.(11°)4483. H found 93°± : 5″± : 9 . . . 10 (1820).

H 3009. χ *Capricorni.* 6 . . . 11 . . . 12.2

R.A. = 21ʰ 1ᵐ 41ˢ
Decl. = − 21° 41′

A and B

1900.687	66°0	67″17
.742	66.2	66.82
1900.71	66.1	67.00

B and C

1900.687	89°3	18″17
.742	89.5	18.33
1900.71	89.4	18.25

The proper motion is small, 0″053 in 186°0. There is a 15m star 110°9 : 39″2 from A. H gives 68°5 : 70 ±; 90 ± : 10 ± (1830).

OΣ 527

R.A. = 21ʰ 2ᵐ 1ˢ
Decl. = + 4° 40′

1900.551	272°3	0″46
.553	266.7	0.41
1900.55	269.5	0.43

H 3011. D.M.(5°)4707. 8.2 . . . 14.5

R.A. = 21ʰ 2ᵐ 1ˢ
Decl. = + 5° 10′

1900.703	232°6	17″08
.706	232.8	17.39
1900.70	232.7	17.23

The principal star has a proper motion of 0″170 in 206°0 (Porter). The only measure is: 255°4 : 20″± (1830). There is a 6″3 pair of 11m stars from A, 269° : 148″.

OΣ 428 *rej.* 7.9 . . . 9.7

R.A. = 21ʰ 3ᵐ 1ˢ
Decl. = + 6° 10′

1901.531	256°5	24″11
.586	256.1	24.21
1901.56	256.3	24.16

Without change.

Harvard Zones. 8.9 . . . 9.2

R.A. = 21ʰ 4ᵐ 0ˢ
Decl. = + 0° 49′

1901.531	318°7	0″94
.586	315.1	0.79
1901.56	316.9	0.86

Noted as double in the Harvard Zones. This is D.M.(0°)4674. Only measured as follows:

1877.06	318°3	0″72	3*n*	⅃

S 779. L 41086. 7.5 . . . 8.5

R.A. = 21ʰ 4ᵐ 26ˢ
Decl. = + 38° 14′

1900.725	10°3	112″77
1901.260	10.5	112.37
1900.99	10.4	112.57

There are two or three faint stars between, and many in the field. The only other measures are:

1824.81	10°8	114″78	2*n*	South

Σ 2778. 8.5 . . . 10.5

R.A. = 21ʰ 9ᵐ 28ˢ
Decl. = − 1° 44′

1900.551	273°3	19″63
.553	273.0	19.90
1900.55	273.1	19.76

Σ's distance in 1828 of 21″19 seems to be too large.

1865.33	269°9	20″21	5*n*	⅃
1880.72	271.2	19.91	2*n*	β

H 5516

R.A. = 21ʰ 10ᵐ ±
Decl. = + 2° 29′

Described by H, "quadruple; all in a line," the principal star 9m and the others 18m and 20m. This place was carefully swept over, but nothing found which seemed to answer the description.

A.G.C. 13. τ *Cygni*

R.A. = 21ʰ 10ᵐ 0ˢ
Decl. = + 37° 32′

1897.689	324°6	0″94
1898.345	322.2	0.78
.482	322.1	0.86
1898.17	323.0	0.86

β 163

R.A. = 21ʰ 12ᵐ 47ˢ
Decl. = + 11° 4′

1900.782	9°1	82″41
1901.471	9.5	82.55
.512	9.3	82.35
1901.25	9.3	82.44

I have measured this 10.9m distant star for the purpose of having hereafter an independent value of the proper motion of AB.

H 5265. 9.6 . . . 10.1

R.A. = 21h 15m 10s
Decl. = − 22° 53′

1901.589	191°9	31″68
.758	193.7	31.56
1901.67	192.8	31.62

The principal star is Cord.D.M.(22°)15347. This pair was put on the list to see if the apparent change in distance was real.

1879.65	19°1	22″85	1*n*	Cin[5]
1890.57	191.1	32.19	2*n*	Glasenapp

Evidently without change.

H 281. D.M.(16°)4505. 8.7 . . . 9.2

R.A. = 21h 15m 32s
Decl. = + 16° 14′

1901.589	333°9	13″97
.729	335.3	14.09
1901.66	334.6	14.03

No change since measures of Leavenworth in 1896 and Cin in 1879. H made the distance 17″52 (1829.57).

H 3023. β *Equulei*

R.A. = 21h 16m 56s
Decl. = + 6° 18′

A and B

1901.509	258°3	33″86
.589	258.9	33.88
1901.55	258.6	33.87

C and D

1901.509	188°1	6″13
.589	187.6	5.48
1901.55	187.8	5.80

A and C

1901.589	306°0	68″49

A and E

1901.589	275°3	93″49

S 788. 7.2 . . . 7.3

R.A. = 21h 17m 31s
Decl. = − 7° 6′

1900.473	88°1	44″15
.476	88.0	44.43
1900.47	88.0	44.29

No other measures since 1824.

1824.78	83°5	36″78	2*n*	South

The components are L 41562 and L 41563. The change in distance is supported by the meridian positions, which give, Lalande 37″25 (1800) and Lamont 39″35 (1850).

H 5517. 18 *Aquarii*

R.A. = 21h 17m 37s
Decl. = − 13° 23′

H has "a most minute point strongly suspected," and gives 270° : 13″ (1823). I have looked for this many times in the last twenty years with various apertures, without finding anything of this kind. The 40-in. shows nothing nearer than the distant star measured in 1877.

Hd 165

R.A. = 21h 19m 48s :
Decl. = − 28° 50′ :

The description in the Harvard Observations is 137° : 10″ ± : 8½ . . . 11 (1868.82). There certainly is no such pair in or anywhere near this place. I looked for it in 1876, and again with the 40-in. It may be identical with a Cin pair, having about the same R.A., but 8° north of the Hd place. The description agrees: 142°9 : 8″22 : 8 . . . 10 (1879.54).

H 5271. 10.6 . . . 11.6

R.A. = 21h 20m 44s
Decl. = − 25 24′

1901.760	43°6	6″27
.799	48.0	6.68
1901.78	45.8	6.47

Herschel gives :

1834.6	40°7	1″5±	1*n*	H

H 1668. 8.4 . . . 9.5

R.A. = 21h 31m 56s
Decl. = + 23° 8′

1901.414	34°8	8″16
.416	37.0	8.31
.473	36.2	8.23
1901.43	36.0	8.23

H gives 34°2 : 7″± : 10 . . . 12 (1828). Noted as double in A.G.

H 941. 4 *Pegasi.* 6 . . . 12.0

R.A. = 21h 32m 31s
Decl. = + 5° 14′

1901.471	337°.7	26″.31
.509	336.2	26.29
.512	338.3	26.10
1901.50	337.4	26.23

H called the small star 17m. The large star has a proper motion of 0″.103 in 84°.5 (Boss.). The only measures are:

1878.71	344°.9	25″.95	1*n*	β

S 798 = H VI. 103. ε *Pegasi*

R.A. = 21h 38m 17s
Decl. = + 9° 20′

A and B

1901.760	325°.0	82″.16
.818	324.8	82.00
1901.79	324.9	82.08

A and C

1901.760	320°.9	140″.88
.818	321.8	141.34
.835	321.1	141.11
1901.80	321.3	141.11

The proper motion of A is very small, 0″.016 in 132°.9. The following are all the measures:

AB	1782.97	322°.7	90″.93	1*n*	H
	1879.54	325.2	81.36	2*n*	β
AC	1825.18	323.0	138.51	2*n*	South
	1874.77	321.6	140.41	3*n*	⅃

μ *Cygni*

R.A. = 21h 38m 46s
Decl. = + 28° 12′

A and C

1900.647	271°.5	40″.99
.684	271.2	41.06
1900.66	271.3	41.02

This 12.2m star was added by me with the 18½-in. The only measures are:

1878.91	263°.2	35″.34	3*n*	β

With this place and the proper motion of A (0″.353 in 135°.4) the computed position of C at the above date is 272°.4 : 41″.32. It is therefore evident that C does not belong to the binary system.

H 285. 11.5 . . . 11.6

R.A. = 21h 39m 4s
Decl. = + 10° 7′

1901.531	66°.2	7″.44
.601	68.2	7.85
1901.66	67.2	7.64

H estimated distance 2″ to 3″. It is near D.M. (10°)4617.

H N. 74 = H 947. 7 . . . 10.7 . . . 11.7

R.A = 21h 45m 57s
Decl. = + 19° 16′

A and B

1901.799	94°.3	19″.78
.818	94.1	20.15
1901.81	94.2	19.96

A and C

1901.799	322°.4	24″.32
.818	321.7	24.34
1901.81	322.0	24.33

Not measured by either Herschel. The only other measures are my own in 1879, which show no change.

Sh 336. 7.5 . . . 8.1

R.A. = 21h 52m 36s
Decl. = + 5° 27′

1901.608	224°.8	101″.05
.739	224.5	100.68
1901.67	224.6	100.86

The other measures indicate some change in distance.

1823.77	226°.0	105″.86	1*n*	Sh
1881.56	224.9	102.17	3*n*	β

The components are D.M.(5°)4915 and 4913.

H. C. Wilson

R.A. = 21h 54m :
Decl. = + 1° 20′ :

The description in Cin[ti] is 212°.1 : 1′.20 : 8 . . . 9 (1882.76) 1*n*. There is no such pair in or near this place. All the stars are much smaller than 8m. The description is not unlike Σ 2856, which is 5m*f* and 3°*n*.

Howe. L 42909. 8 . . . 10.8 . . . 10.5

R.A. = 21h 55m 0s
Decl. = − 16° 1′

A and B

1901.605	271°.6	9″.12
.739	270.9	9.14
1901.67	271.2	9.13

A and C (= H 5524)

1901.605	292°.4	102″.02
.739	291.9	101.71
1901.67	292.1	101.86

No other measures of AC. AB unchanged.

H 289 = H 5525. 20 *Pegasi.* 6 . . . 11.4

R.A. = 21h 55m 14s
Decl. = + 12° 33′

1901.799	324°.6	52″.98
.818	324.3	52.84
1901.81	324.4	52.91

The prior measures are:

1878.95 325°.5 51″.06 3*n* β

The proper motion of A is 0″.068 in 136°.9, which corresponds to the change in distance shown by the measures.

OΣ (*App*) 228. 8.1 . . . 8.7

R.A. = 21h 55m 51s
Decl. = + 4° 12′

1901.512	27°.2	75″.67
.604	27.4	75.60
1901.56	27.3	75.63

The smaller star not in D.M. The other is D.M. (4°)4788. A has a proper motion of 0″.145 in 163°.2, which explains the change.

1875.69 28°.0 73″.52 3*n* Δ

There is a 12m star from A, 157°.9 : 25″.66 (1901.60) 1*n*.

π¹ *Pegasi*

R.A. = 22h 3m 54s
Decl. = + 32° 35′

A and B. B = 13.5

1900.684	317°.6	27″.42
.687	316.9	27.04
1900.68	317.2	27.23

A and C. C = 11

1900.684	262°.3	71″.67
.687	262.3	71.74
1900.68	262.3	71.70

A and D. D = 11.5

1900.684	89°.3	187″.49	Single dist.
.687	89.3	187.51	" "
1900.68	89.3	187.50	

The only prior measures are mine in 1879. There is an error in the printed angle of AB; it should be 314°.4.

Σ 2866 = H 1734

R.A. = 22h 4m 13s
Decl. = + 40° 4′

1901.722	53°.3	9″.16
.796	53.6	9.18
1901.76	53.4	9.17

No recent measures, but unchanged.

H 1735. L 43266. 7.2 . . . 8.7 . . . 11.2

R.A. = 22h 4m 21s
Decl. = + 44° 15′

A and B

1901.608	110°.1	27″.18
.758	110.1	27.07
1901.68	110.1	27.12

B and C

1901.608	164°.7	22″.78
.758	164.0	22.70
1901.68	164.3	22.74

No other measures. The Decl. in H is 1° too large. A and B are D.M.(44°)4059 and 4060.

H 3094. 10.7 . . . 10.7

R.A. = 22h 5m 9s
Decl. = + 2° 21′

1900.780	301°.6	4″.80
1901.531	301.7	5.15
1901.15	301.6	4.97

H gives 315°.5 : 3″± : 10 . . . 10 (1830). A little *p* this, and about 2′*s* is a similar pair, components equal, and same as the other pair; 114°.6 : 3″.72 (1901.15) 2*n*. H 957, 310°± : 2″± : 11 . . . 11+ (1820) should be 20′*n* of H 3094, but I could find only the pairs measured, and the last named probably identical with one of the others.

H 1741. B.A.C. 7746. 6.2 . . . 9.7

R.A. = 22h 6m 29s
Decl. = +50° 14′

1900.681	308°.5	25″.21
.687	309.8	25.49
1900.68	309.1	25.35

The principal star has a proper motion of 0″.151 in 62°.5, which accounts for the change.

1828	328°.5	20″±	1n	H
1876.29	316.8	23.22	1n	J
1900.68	309.6	25.04	2n	Espin

Σ 2875 *rej.* S.D.(8°)5835. 8.8 . . . 11.6

R.A. = 22h 7m 23s
Decl. = − 8 24′

1901.605	44°.1	15″.00
.758	45.6	14.62
1901.68	44.8	14.81

No other measures.

H I. 49

R.A. = 22h 8m 3s
Decl. = +60° 10′

Given by H as Class 1 with angle 4°.2 (1783.06). The place is that of a 6.7m star. I looked for this carefully in 1876, and now with the 40-in., and there is certainly nothing there. There must be a large error in place.

H 293 = Σ 2888 *rej.* 8.7 . . . 11.0

R.A. = 22h 11m 2s
Decl. = +12° 22′

1900.742	276°.8	18″.41
1901.509	276.8	18.80
.512	275.4	18.44
1901.25	276.3	18.55

This is D.M.(12°)4794. The only prior measures are by H, 276°.4 : 10″± : 9 . . . 13 (1820).

H 3104. S.D.(17°)6488. 9.3 . . . 9.5

R.A. = 22h 12m 35s
Decl. = −17° 42′

1901.760	76°.1	10″.39
.799	74.8	10.15
1901.78	75.5	10.27

Only H, 83°.9 : 8″± (1830).

Σ 2892 *rej.* 8.4 . . . 11.1 . . . 9.2

R.A. = 22h 12m 55s
Decl. = − 11 24′

A and B

1901.760	59°.1	11″.86
.799	56.0	11.53
1901.78	57.5	11.69

A and C

1901.760	263°.1	35″.96
.799	262.6	35.98
1901.78	262.8	35.97

In *Mens. Microm.*, p. xxxiv, Σ gives:

1831.32	50°.0	9″.0
1831.32	266.0	35.0

Howe

R.A. = 22h 14m :
Decl. = + 5° 3′ :

The measure by Howe in Cin[5] is 121°.6 : 1″.03 : 8.5 . . . 9.0 (1879.64) 1n. This pair should be 8′ south of the triple 30 *Pegasi*. There is no such pair either in or anywhere near the given place. All the neighboring stars were examined. It is undoubtedly identical with β 842, which is about 10m*p* and 3′*n* of the place given above. The description corresponds exactly.

D.M.(10°)4731. 8 . . . 11

R.A. = 22h 14m 25s
Decl. = +10 26′

1901.589	305°.1	39″.78
.609	305.4	40.12
1901.60	305.2	39.95

H observed this star for Σ 2998, which is 2m*f*; 310°.7 : 35″± (1830). He called the components *orange* : *blue*. A appears yellowish, but no noticeable color in B.

H 3106. γ *Aquarii*

R.A. = 22h 15m 27s
Decl. = − 1 59′

1901.586	131°.2	41″.98
.605	132.8	42.35
1901.59	132.0	42.16

The only measures of this 12.2m star are:

1838.76	125°.9	49″.46	1n	Lamont
1878.72	129.6	43.87	1n	β

The principal star has a proper motion of 0″.103 in 80°.5.

OΣ (*App*) 231. L 43659. 8.2 . . . 8.4

R.A. = 22ʰ 16ᵐ 37ˢ
Decl. = + 9° 20′

1901.608	110°.2	90″.79
.739	110.3	90.92
1901.67	110.2	90.85

The only measures are:

1875.74	109°.8	91″.02	3n	Δ

H 1756. 6.7 . . . 10.6 . . . 13.2

R.A. = 22ʰ 16ᵐ 42ˢ
Decl. = + 40° 4′

A and B

1901.722	286°.6	21″.85
.739	286.4	22.31
1901.73	286.5	22.08

A and C (new)

1901.722	325°.8	22″.47
.739	325.8	22.39
1901.73	325.8	22.43

H gives for AB 283°.5 : 15″± : 9 . . . 12 (1828). The magnitude of A in D.M. is 6.5.

H 3108 = OΣ (*App*) 232. 8.4 . . . 8.4

R.A. = 22ʰ 17ᵐ 34ˢ
Decl. = + 3° 14′

1901.799	190°.9	67″.67
.818	190.9	67.49
1901.81	190.9	67.58

The other measures are:

1875.98	190°.4	65″.72	4n	Δ

W² XXII. 382. 8.8 . . . 9.0

R.A. = 22ʰ 18ᵐ 31ˢ
Decl. = + 40° 18′

1901.473	52°.3	6″.59
.722	55.0	6.49
.739	53.6	6.69
1901.64	53.6	6.59

In Weisse "duplex 6″." No other measures.

H 3116. D.M.(6°)5023. 9.5 . . . 12.5

R.A. = 22ʰ 21ᵐ 15ˢ
Decl. = + 6° 56′

1901.720	257°.7	25″.52
1902.471	257.8	25.95
1902.09	257.7	25.73

No measures in H; "estimated from diagram."

Harvard Zones. 9.5 . . . 9.6

R.A. = 22ʰ 22ᵐ 53ˢ
Decl. = + 0° 40′

1901.720	181°.5	3″.04
.760	182.5	3.22
1901.74	182.0	3.13

Noted in Hd Zones, *nf* : 3″±. No other measures. It is D.M.(0°)4879.

Krueger 60

R.A. = 22ʰ 23ᵐ 43ˢ
Decl. = + 57° 3′

A and B

1901.318	133°.3	3″.25
.320	130.5	3.37
.375	131.4	3.38
.473	130.4	3.42
1901.37	131.4	3.35

A and C

1901.318	58°.8	36″.59
.320	58.5	36.26
.375	58.4	36.69
.473	58.8	36.66
1901.37	58.6	36.55

A and D

1901.318	98°.7	66″.73
.328	98.4	66.95
.375	98.5	67.57
1901.34	98.5	67.08

A and D.M.(56°)2784

1901.318	144°.62	199″.31
.320	144.72	199.50
.375	144.63	199.15
.474	144.52	199.65
1901.37	144.62	199.40

It was apparent soon after the first remeasurement of A by Doolittle that these stars belonged to the type of 61 *Cygni*, where the change in the relation of the components is due to their different proper motions. These are small stars, and their movement in space had not been noticed by meridian observers and those interested in stellar motions.

To determine whether or not the third star, measured by me in 1890, has any proper motion of its own, I have connected A with the nearest bright star, D.M.(56°)2784. The positions of A and this star are in the A. G. catalogue, and these give for the relation of the two 151°.9 : 195″.35 (1873.2). Comparing this with my direct measures, assuming that the distant star is fixed, we have for the proper motion of A

0″.903 in 247°.2. The present measures of AC and those of 1890 make this value 0″.927 in 244°.9. The close agreement of these results makes it practically certain that the change is solely due to the movement of A. Taking the mean, 0″.915 in 246°.0, as the best value for this motion, and my measures of AB in 1890 and 1901, we have for the proper motion of B 0″.702 in the direction of 239°.0.

H 5528

R.A. = 22h 31m 22s
Decl. = + 8° 11′

H gives 90 ± : 1½″ : 11 . . . 12 (1823); "elongated; not fairly divided." The place is exactly that of the 9.1m star, D.M.(8°)4902 = W¹ XXII. 631. I looked at this star with the 6-in. in 1876, and with the 18½-in. in 1877 without seeing any indication of duplicity. I could find no pair in or near this place with the 40-in.

H 5529. κ *Aquarii*

R.A. = 22h 31m 32s
Decl. = − 4° 51′

H describes this 290°± : 4½″± (1827); "an exceedingly minute point strongly suspected." I have looked in vain for this many times in past years. The 40-in. under fine conditions failed to show any companion. The principal star has a proper motion of 0″.142 in 219°.2.

ζ *Pegasi*. . . . 12.0

R.A. = 22h 35m 38s
Decl. = + 10° 12′

1900.515	139°.1	63″.45
.551	138.9	63.72
1900.53	139.0	63.58

The only measures are:

1879.54	137°.8	64″.33	1n	β

The proper motion is 0″.067 in 105°.5, and this appears to account for the change in distance.

H N. 140. L 44382. 6.5 . . . 9.1

R.A. = 22h 35m 51s
Decl. = − 5° 44′

1901.589	262°.2	75″.21
.703	262.4	75.33
1901.64	262.3	75.27

No measures in H, but called Class II. The place is given by H as above. There is nothing of Class II in or near this place.

Σ 2933 *rej.* D.M.(10°)4801. 9.2 . . . 10.4

R.A. = 22h 36m 49s
Decl. = + 10° 22′

1901.586	218°.4	4″.10
.589	215.3	4.42
1901.58	216.8	4.26

No other measures.

H 3139. 13 . . . 13

R.A. = 22h 38m 37s
Decl. = + 4° 43′

1900.725	208°.5	2″.17
.742	221.7	2.80
1900.73	215.1	2.48

Described by H, 142° : 2 ± : 11 = 11 (1830). The pair measured is in the correct place substantially, but description does not agree. In the field is a triangle of 11m stars, the side of which is about 23″. The *f* star of this triangle is 98°.3 : 33″.1 from A of the double.

H 301. ξ *Pegasi*. 5 . . . 12.2

R.A. = 22h 40m 42s
Decl. = + 11° 33′

1897.714	110°.5	12″.22
1898.492	108.0	12.61
.502	110.3	12.08
1900.515	110.6	12.36
.551	109.1	12.22
.553	109.3	12.43
1899.39	109.6	12.32

H called the small star 18m, and gave the angle 122°.8 (1820). There are no other early measures. The large star has a considerable proper motion, 0″.541 in 158°.9, and the companion is moving with it.

1866.79	117°.7	12″.17	2n	ℷ
1879.38	112.6	11.93	4n	β

OΣ 480 = H 1809

R.A. = 22h 41m 19s
Decl. = + 57° 27′

1900.742	117°.3	30″.76

Without change. In 1873 I thought the principal star was elongated, but it was round with all powers at the time of the above measure.

H VI. 97. τ^2 *Aquarii.* . . . 9.5

R.A. = 22^h 43^m 14^s
Decl. = − 14° 13′

1900.647	294°.4	133″.33
.666	293.9	132.95
1900.65	294.1	133.14

No measures in the last seventy-five years.

1783.60	288°.5	123″.61	1*n*	H
1825.30	292.4	133.44	2*n*	S

The proper motion is very small, 0″.059 in 227°.5.

H 1825. D.M.(12°)4904. 9.0 . . . 9.3

R.A. = 22^h 47^m 50^s
Decl. = + 12° 58′

1900.553	223°.2	1″.77
.666	222.2	1.77
1900.61	222.7	1.77

H gave 230°± : 1″± : 10 . . . 11 (1828); "very delicate; could not verify it, having mislaid the high power." No other measures. In 1876 I looked up and estimated distance 1″.2.

H 3152. L 44810

R.A. = 22^h 48^m 40^s
Decl. = − 10° 1′

Given by H 135°.4 : 3″± : 9 . . . 15 (1830). "Large star very red. A very difficult object. Measured with 320, which still left a suspicion of illusion, though I have hardly a doubt." I have looked for this several times previously with apertures up to 18½-in., but have never seen any trace of a companion. It was examined on two nights with the 40-in.

H 974. D.M.(4°)4921. 8.7 . . . 9.7

R.A. = 22^h 49^m 20^s
Decl. = + 4° 11′

1901.529	88°.5	44″.33
.531	88.3	44.27
1901.53	88.4	44.30

H has 91°.5 : 40″± : 9 . . . 12. A has a proper motion of 0″.11 in 213°.7 (Boss.).

Σ 2972 *rej.* D.M.(−0°)4451. 9.3 . . . 11.7

R.A. = 22^h 56^m 34^s
Decl. = − 0° 23′

1901.589	147°.4	15″.42
.605	148.5	15.56
1901.60	147.9	15.49

Only H, who has 198°.0 : 12″± : 9–10 . . . 14 (1830). The angles do not agree. Two other similar pairs were measured in the immediate vicinity. The first is D.M.(−0°)4445, 159°.1 : 24″.40 : 8.5 . . . 12.7 (1901.60) 1*n*; and the other D.M.(−0°)4453, 172°.7 : 19″.14 : 10.8 . . . 10.9 (1901.60) 1*n*. The latter star is 9.5m in D.M.

H 3164. L 45137. 6.9 . . . 12

R.A. = 22^h 58^m 52^s
Decl. = − 17° 44′

1901.586	129°.5	55″.05
.758	130.0	55.11
1901.67	129.7	55.08

Only H, 136°.5 : 30″± (1830).

Christiania A.G. 3744. 8.8 . . . 9.0

R.A. = 23^h 6^m 11^s
Decl. = + 65° 15′

1901.318	265°.4	14″.83
.474	265.0	14.91
1901.40	265.2	14.87

No change since my measures in 1891.

H 1855. 10 . . . 10

R.A. = 23^h 6^m 18^s
Decl. = + 44° 56′

1900.782	111°.2	4″.44
1901.320	113.0	4.64
1901.05	112.1	4.54

H gives 296°.7 : 1½″ : 11 = 11 (1828). Not in D.M., but the place is correct.

Σ 2993

R.A. = 23^h 7^m 47^s
Decl. = − 9 35′

A and B

1900.515	176°.6	25″.41
.744	176.9	25.38
1900.63	176.7	25.39

No relative change, but they have a common proper motion of 0″.519 in 93°.4. There is a distant star not moving with the others.

1900.515	114°.5	126″.08		
.666	114.5	126.17		
.744	114.5	125.85		
1900.61	114.5	126.07		
1824.82	109°.2	158″.17	2*n*	South

β 182

R.A. = 23ʰ 10ᵐ 52ˢ
Decl. = − 14° 28′

A and B

1900.742	41°.4	0″.60
1901.586	43.3	0.56
1901.16	42.3	0.58

AB and C

1900.666	77°.5	69″.49
.742	77.7	69.56
.744	77.2	69.61
1900.72	77.5	69.55
1901.586	77°.0	70″.03
.608	77.4	70.20
1901.59	77.2	70.11

I measured the distant star first in 1898 in order to get an independent value for the large proper motion given the close pair from meridian observations (1″.302 in 201°.2).

1898.66 79°.9 68″.04 2n β

The measures indicate that this unusually large proper motion for a faint star is substantially correct.

H 3183. 9.1 . . . 12.1 . . . 12. 1

R.A. = 23ʰ 11ᵐ 43ˢ
Decl. = − 2° 23′

A and B

1901.605	95°.3	95″.76
.720	95.9	95.60
1901.66	95.6	95.68

B and C

1901.605	11°.2	4″.37
.720	16.3	4.31
1901.66	13.7	4.35

A is S.D.(2)5921. H gives for BC 12°.3 : 2″± (1830).

H VI. 61

R.A. = 23ʰ 14ᵐ 14ˢ
Decl. = + 4° 44′

Herschel's place is that of 7 *Piscium*. His description is, "they form a triangle, each side of which is about 1′," and speaks of it as near the bright star. I could not find anything here which could be satisfactorily identified.

H 3185. Neb. . . . 13.4

R.A. = 23ʰ 15ᵐ 36ˢ
Decl. = + 8° 14′

1901.720	164°.0	21″.12
.760	163.3	21.37
1901.74	163.6	21.24

Described by H, 160°± : 14 . . . 14 (1830); "a double with some nebulous appendage." A of the above measures is a faint nebula (Dreyer 7634). No star was seen in the nebula.

H 1889. 7.7 . . . 12 . . . 11.7

R.A. = 23ʰ 26ᵐ 4ˢ
Decl. = + 37° 39′

A and B

1900.706	241°.4	44″.05
.744	241.1	43.80
1900.72	241.2	43.92

A and C

1900.706	57°.8	55″.79
.744	57.1	55.84
1900.72	57.4	55.81

H gives AB 238°.2 : 20″±; AC, 58°.2 : 25″± (1828). There is a 13.5m star from A 211°.8 : 29″.6.

Winnecke. 8.5 . . . 9.2

R.A. = 23ʰ 26ᵐ 35ˢ
Decl. = + 30° 47′

1901.796	164°.9	1″.59
.815	166.0	1.37
1901.80	165.4	1.48

The only measures are:

1863.85 168°.5 1″.51 2n Wn

There is a 13.5m star 133°.2 : 23″.4, and a 3″ pair of 10.5m stars in the field *sp*. The principal star has a proper motion of 0″.148 in 61°.4 (Kustner). Evidently the components are moving together.

H N. 35 = H 316. 6.9 . . . 10.8

R.A. = 23ʰ 31ᵐ 27ˢ
Decl. = − 13° 44′

1901.608	92°.9	33″.21
.758	92.7	33.09
.796	92.3	33.37
1901.72	92.6	33.22

The only prior measures:

1877.83 92°.7 33″.22 1n β

H 1898. κ *Andromedae.* 4 . . . 11.1 . . . 11.1

R.A. = 23h 34m 30s
Decl. = + 43° 40′

A and B

1901.625	191°9	46″82
.815	191.6	46.69
1901.72	191.7	46.75

A and C

1901.625	294°5	105″08
.815	294.8	104.83
1901.72	294.6	104.95

The proper motion of A is 0″078 in 107°8, which explains the change in the distance of C.

1879.24	188°7	46″64	3*n*	β
1879.24	294.6	103.17	1*n*	β

W¹ XXIII. 696

R.A. = 23h 35m 7s
Decl. = − 5° 5′

"Duplex" in Weisse, but this is an error, as this star is not a double of any class. The wide pair measured for this in Cin⁵ is 1m 28s*p* and 5″5*n*. No change in that.

1901.796	67°5	42″02	9.0 . . . 9.5	1*n*

Σ 3032 *rej.* L 46416. 8.3 . . . 10.0

R.A. = 23h 35m 16s
Decl. = + 14° 7′

1901.720	338°9	19″23
.758	339.0	19.23
1901.74	338.9	19.23

The only observations by H, 339°5 : 15″ ± (1828).

Harvard Zones. 9.7 . . . 13.0

R.A. = 23h 35m 50s
Decl. = + 0° 41′

1901.605	146°0	75″64
.608	146.3	75.64
1901.60	146.1	75.64

In Hd Zones *sf* : 30″ ± : 9 . . . 14. A is D.M.(0°) 5035.

Egbert. D.M.(16°)4980. 8.7 . . . 8.8

R.A. = 23h 40m 26s
Decl. = + 16° 25′

1901.608	88°2	1″32
.703	85.5	1.22
1901.65	86.8	1.27

Given with approximate place in Cin:

1879.66	89°0	1″37	2*n*	Cin

Also noted as double in A.G.

Δ 28. D.M.(62°)2296. 8.6 . . . 10.8 . . . 10.1

R.A. = 23h 41m 32s
Decl. = + 62° 33′

A and B

1900.742	357°9	1″73
1901.722	359.2	1.56
1901.23	358.5	1.64

A and C

1900.742	144°7	10″43
1901.722	144.8	10.54
1901.23	144.7	10.48

Discovered by Dembowski in 1876. Only his measures:

1877.29	358°6	1″61	3*n*	Δ
1877.29	143.6	10.33	3*n*	Δ

S 835. 20 *Piscium.* 6 . . . 8.6

R.A. = 23h 41m 46s
Decl. = − 3° 26′

1900.553	285°0	172″65
.666	285.3	172.81
1900.61	285.1	172.73

The only prior measures are:

1824.83	287°2	170″92	2*n*	South

W² XXIII. 896

R.A. = 23h 43m 15s
Decl. = + 24° 41′

"Duplex" in Weisse, but certainly not double.

W[1] XXIII. 865

R.A. = 23h 43m 40s
Decl. = +16° 12′

"Duplex" in Weisse. Examined twice, and not a double of any kind.

H 319. D.M.(10°)5003. 9.5 . . . 11.7

R.A. = 23h 45m 42s
Decl. = +10° 37′

1901.605	285°.1	15″.49
.608	284.3	15.29
1901.60	284.7	15.39

No other measures.

W[1] XXIII. 1008. 9.0 . . . 9.1

R.A. = 23h 50m 40s
Decl. = − 1° 11′

1900.780	253°.4	11″.86
.782	254.0	11.76
1900.78	253.7	11.81

"Duplex" in Weisse. No other measures.

H 321. 7.5 . . . 11.2

R.A. = 23h 51m 38s
Decl. = +10° 48′

1901.703	132°.9	20″.30
.720	132.3	20.64
1901.71	132.6	20.47

No other measures.

D.M.(10°)5017. 8 . . . 12.5

R.A. = 23h 53m 39s
Decl. = +10° 35′

1901.608	122°.7	25″.76
.760	120.7	25.56
1901.68	121.7	25.66

Measured the first time by mistake for the preceding pair, H 321. No other observations.

Camb. A.G. 14394

R.A. = 23h 51m 16s
Decl. = +26° 15′

Noted in Camb. A.G. as a "close double." I have looked at this 6.5m star three times in 1901. On the last occasion 85 *Pegasi*, which is close by, was easily measured. At no time was there any indication of this star being a double of any kind.

Duner. D.M.(6°)5233. 9.0 . . . 9.5

R.A. = 23h 55m 11s
Decl. = + 7° 2′

1900.666	264°.8	15″.04
.668	263.8	15.11
1900.66	264.3	15.07

The only measures are:

1869.31	265°.3	15″.26	3*n*	Duner

β 733. 85 *Pegasi*

R.A. = 23h 55m 54s
Decl. = +26° 27′

A and B

1900.854	253°.0	0″.97

A and C

1900.854	342°.6	36″.65
.873	342.1	36.55
1900.86	342.3	36.60

W[1] XXIII. 1147

R.A. = 23h 56m 49s
Decl. = + 2° 43′

"Duplex" in Weisse. There is no companion star near enough to be mentioned.

II. NEW DOUBLE STARS

β 1291. D.M.(37°)94. 8.4 . . . 12.8

R.A. = 0h 28m 56s
Decl. = +37° 2′

1900.725	168°.7	2″.94
.742	169.0	2.75
.780	169.6	2.85
1900.75	169.1	2.78

β 1292. D.M.(3°)161. 8.5 . . . 9.0

R.A. = 1h 1m 35s
Decl. = + 3° 46′

1900.780	24°.5	0″.31
1901.586	21.8	0.36
.796	26.4	0.23
1901.39	24.2	0.30

β 1293. L 5287. 7.1 . . . 10.7

R.A. = $2^h 45^m 56^s$
Decl. = + 46 40′

1900.687	352°6	1″73
.780	350.9	1.68
.782	352.9	1.75
1900.75	352.1	1.72

Found in measuring Σ 324 *rej.*, which is $2^m 31^s f$ and 0′9*s*.

β 1294. D.M.(46°)734. 8.8 . . . 8.9

R.A. = $3^h 12^m 24^s$
Decl. = + 46° 15′

1901.589	228°9	6″33
.742	226.8	6.26
.758	227.7	6.14
1901.69	227.8	6.24

The components are red and green. The D.M. magnitude of A is 9.2.

β 1295. 2 *Camelopardali.* 5 . . . 7

R.A. = $4^h 30^m 27^s$
Decl. = + 53° 14′

A and B

1901.758	139°2	0″15
.796	138.5	0.25
.818	140.7	0.21
.854	143.3	0.24
1901.80	140.4	0.21

AB and C (= Σ 566)

1900.780	290°0	1″61
.782	286.5	1.60
1901.589	289.5	1.42
1901.05	288.7	1.54

AB and D

1900.780	212°4	23″13
.782	212.5	23.35
1901.589	213.6	23.30
1901.05	212.8	23.26

The principal star of the Σ pair is a close and somewhat unequal double, and is certainly a binary system, and probably in rapid motion. The Σ companion was measured by me in 1888 with the 36-in., and the close pair would have been detected with the present distance. The large star has a proper motion of 0″100 in 153°2 (Porter), which is also the movement of the old companion. That star is in slow retrograde motion about the close pair, as will be seen from the following measures:

1829.79	311°4	1″58	4*n*	Σ
1846.44	304.6	1.61	3*n*	OΣ
1870.02	299.0	1.63	3*n*	⅃
1888.92	291.9	1.58	3*n*	β
1901.05	288.7	1.54	3*n*	β

The small star D was added by me with the 36-in. The only other measures are:

1888.92	209°8	23″66	3*n*	β

With this position and the proper motion of AB the place of C at the date of my last measures should be 212°3 : 23″16 (1901.05). As this is practically identical with the measures, it is certain that the small star does not belong to the triple system.

β 1296. L 12112. 8.0 . . . 8.5

R.A. = $6^h 14^m 6^s$
Decl. = − 7° 12′

1900.780	201°0	0″21

A close and difficult pair found in measuring H 2315, which is $58^s f$ and 3′2*s*.

β 1297. S.D.(22°)4158. 8.7 . . . 9.5

R.A. = $16^h 15^m 10^s$
Decl. = − 22° 21′

1901.359	140°6	1″91
.395	137.0	1.92
.433	137.7	1.90
1901.39	138.4	1.91

Found in looking for H 4851.

β 1298. 7.6 . . . 8.9

R.A. = $16^h 53^m 49^s$
Decl. = + 9 52′

A and B

1901.531	91°7	0″26
.586	88.0	. . . .
.589	84.8	0.33
1901.57	88.2	0.29

AB and C (= OΣ *App* 150)

1901.359	165°4	76″44
.375	164.9	76.62
.586	164.8	76.57
1901.44	165.0	76.54

C and D (= Σ 2111 *rej.*). 8.5 . . . 12

1901.359	164°0	23″91
.375	161.5	24.19
1901.37	164.2	24.05

The principal star of this wide pair is a close and difficult double. The only other measure of C is:

1871.84 165°2 77″02 3*n* ⅃

Probably no sensible proper motion, as the meridian positions by Lamont give 164°5 : 76″74 (1844.5). The close pair has been measured at Mt. Hamilton:

1901.69 92°3 0″26 3*n* Aitken

No other measures of CD.

β 1299. D.M.(10°)3337. 8.5 . . . 8.5 . . . 11.5

R.A. = 17ʰ 51ᵐ 50ˢ, Decl. = + 10° 58′

A and B

1900.476	155°6	0″48
.515	151.6	0.55
1900.49	153.6	0.51

AB and C

1900.476	63°5	26″69
.512	62.7	27.44
.515	62.7	27.13
1900.50	63.0	27.09

The close pair was suspected with the 6-in. in 1872, and subsequently overlooked until the present time.

β 1300. 30 *Sagittarii*. 6 . . . 13

R.A. = 18ʰ 43ᵐ 38ˢ, Decl. = − 22° 15′

1900.473	247°6	21″28
.512	245.6	21.40
1902.567	246.5	21.71
1901.18	246.6	21.46

The large star has a small proper motion, 0″075 in 260°0.

β 1301. L 37588. 8.5 . . . 9.5 . . . 9.5

R.A. = 19ʰ 40ᵐ 25ˢ, Decl. = + 4° 0′

A and BC

1900.551	66°3	56″76
.553	66.7	56.89
.617	67.0	56.74
1900.58	66.7	56.80

B and C

1900.551	336°6	0″66
.553	337.1	. . . .
.742	341.1	0.68
.780	334.1	0.62
1900.66	337.2	0.65

This is 27ˢ*f* and 3′*n* of β 468.

β 1302. D.M.(22°)4170. 8.2 . . . 12.3 . . . 8.4

R.A. = 20ʰ 39ᵐ 32ˢ, Decl. = + 22° 45′

A and B.

1901.414	140°2	2″15
.416	134.7	2.03
.433	142.3	2.21
1901.42	139.1	2.13

A and C

1901.414	209°0	52″31
.416	208.5	52.21
.433	209.2	52.06
1901.42	208.9	52.19

C is D.M.(22°)4169. The A.G. positions give 208°0 : 51″87.

β 1303. L 41147. 7 . . . 13.2

R.A. = 21ʰ 6ᵐ 56ˢ, Decl. = + 2° 19′

1900.551	235°0	3″91
.553	237.5	4.00
.725	236.9	4.14
1900.61	236.5	4.02

β 1304. L 41433. 8.1 . . . 12.7

R.A. = 21ʰ 14ᵐ 7ˢ, Decl. = − 2° 1′

1900.473	57°1	3″29
.476	57.8	3.23
.515	60.9	2.82
1900.49	58.6	3.11

Found in looking for Σ 2778.

β 1305. D.M.(12°)4622. 8.8 . . . 9.9 . . . 10.5

R.A. = 21ʰ 39ᵐ 9ˢ, Decl. = + 10° 14′

B and C

1901.531	50°8	0″97
.760	45.7	0.98
1901.64	48.2	0.97

A and BC

1901.531	90°9	88″46
.605	91.5	88.87
1901.57	91.2	88.66

β 1306. D.M.(22°)4484

R.A. = 21ʰ 43ᵐ 58ˢ
Decl. = + 23° 1′

A and B. 8 . . . 12.3

1901.414	295°7	31″25

C and D (new). 12.9 . . . 13.9

1900.742	95°7	2″12
.780	101.4	1.75
1901.758	102.4	1.59
.854	106.2	1.85
1901.28	101.4	1.83

In measuring the faint star C as a check hereafter on the proper motion of AB as given from meridian positions, it was found to be a rather difficult pair. C has not been measured before. Porter gives the movement :

ding star
t it is evi-
f A is cor-
90°, since
omparing
e of Dem-
n of A, we
movement
ments will
e between
that of 61
irs where
the same

CORRECTIONS

Page 5. O.Arg.N.21. *For* 2″592 *read* 22″59.

13. **Σ 353** *rej.* In the angle by H *for* 56°4 *read* 65°4.

18. D.M.(21°)694. In the note *for* 10 *n read* 10° *n*.

28. **S 550.** *For* L 15459 and 15460 *read* 14559 and 14560.

35. Howe. The pair measured is new. The Howe pair was afterwards found and identified as D.M.(24°) 2709.

37. **Σ 2031** *rej.* *For* D.M.(–1°)3761 *read* D.M.(–1°)3161.

57. *θ Aquilae.* In the proper motion *for* 203°6 *read* 336°7.

60. **OΣ 412** *rej.* In the R.A. *for* 41ᵐ *read* 42ᵐ.

74. **β 1305.** *For* D.M. (12°)4622 *read* D.M.(10°)4622.

. . 13.3

20
78
32

.780	309.2	6.92
1900.73	309.4	6.93

B and C

1900.742	339°5	46″49
.780	338.6	46.62
1901.758	339.1	46.86
1901.09	339.1	46.66

1901.81	63.5	1.10

A and B (= H 1776)

1900.744	274°7	9″06
.782	273.7	9.44
1901.720	273.8	9.52
1901.08	274.1	9.34

The close pair is a difficult object. H gives for AB 277°5 : 5″± (1828).

MICROMETRICAL OBSERVATIONS OF EROS

MICROMETRICAL OBSERVATIONS OF EROS MADE WITH THE FORTY-INCH REFRACTOR OF THE YERKES OBSERVATORY DURING THE OPPOSITION OF 1900-1901

E. E. Barnard

In accordance with the scheme for a systematic series of observations of *Eros*, carried on in this country and in Europe, for a redetermination of the solar parallax, the following observations of the planet have been made with the filar micrometer of the forty-inch telescope.

A few explanations only are necessary for a proper understanding of the measures. The times of observation are referred to the 90° meridian and are $6^h\ 0^m\ 0^s$ slow of Greenwich mean time. The last two columns contain the parallax factors in time and arc.

In the first column for Δa the uncorrected value is given; following this is the correction for refraction. The next column contains the value of the Δa corrected for refraction. The $\Delta\delta$ is treated in a similar manner. In the column immediately following the times is given the number of the comparison star. The magnitudes of these stars are sometimes indicated in this column; but an extra list gives the magnitudes of all the comparison stars. In the next column are the number of independent settings which go to make up the observation — they are generally five in number.

The corrected Δa are yet to be multiplied by $\frac{1}{15}$ sec δ. From the uncertainty of the positions of the comparison stars at present, it has not been thought desirable to reduce these Δa to time.

No correction has been applied to the micrometer screw for temperature, because both screw and tube are of steel, and hence have the same temperature coefficients which, acting in different directions, mutually cancel each other. A shortening or lengthening of the screw by cold or heat is compensated by a corresponding shortening or lengthening of the tube. Observations of *Atlas* and *Pleione* of the *Pleiades*, carried through some five years, have shown that the change of the focal length of the great glass alone is to be taken into account, and only a small portion of this — the difference between the change in the tube and the change in the focus. From summer to winter the focus shortens from the action of the cold upon the lens. The shortening of the focus is greater than that of the tube, the extreme difference being about 0.3 inch, though the entire shortening of the focus is upward of three-fourths of an inch. This difference is the only temperature change that will affect the measures, and is easily taken into account by the following small table, which shows the effect of this difference between change of focus and tube for a measured distance of 300″:

CORRECTIONS FOR FOCUS SCALE READINGS

Change in Scale (inch)		Correction
0.01	=	0.″003
0.05	=	0.016
0.10	=	0.033
0.15	=	0.049
0.20	=	0.066
0.25	=	0.082
0.30	=	0.098
0.35	=	0.114

If the scale reading for focus has not been read, this table can be used in conjunction with the following table, which depends on the temperature, and which has been deduced from the measures of *Atlas* and *Pleione* referred to:

Temperature	Scale Reading	Temperature	Scale Reading
+ 80° (F.)	2.305 inches	+ 25° (F.)	2.132 inches
+ 75	2.290	+ 20	2.116
+ 70	2.274	+ 15	2.101
+ 65	2.259	+ 10	2.085
+ 60	2.244	+ 5	2.069
+ 55	2.227	0	2.054
+ 50	2.212	− 5	2.039
+ 45	2.195	− 10	2.022
+ 40	2.180	− 15	2.006
+ 35	2.163	− 20	1.991
+ 30	2.148	− 25	1.975

It is not recommended that this table be used for these observations of *Eros*, for reasons that will be given in a paper on the focal changes of the great telescope, to be published later.

The extreme change from the setting, 2.20 inches, to which the value of the micrometer screw has been adjusted, and which occurs at a temperature of 50° F., would scarcely exceed 0.10 inch throughout the observations of *Eros*, and would introduce an error of only something like 0″.03 in the largest distance measured.

The value of one revolution of the micrometer screw used in these observations was determined from many measures of the difference of declination of *Atlas* and *Pleione*, *Electra* and *Celaeno*, θ' and θ^2 *Tauri*, etc. This value is 9″.665 and was, as stated, determined for a temperature of 50° F. and a scale reading of 2.20 inches. Should it be thought desirable to correct any of these measures for focal change, it can easily be done from the material here given. So far no correction of this kind has been applied.

The micrometer, made by Warner and Swasey, is illuminated by a small electric lamp, the light from which (Burnham's method) is under instant control, so that the wires can be quickly made faint or bright at will. The current is turned off from this, except when the actual measures are made, so that no heating of the screw will occur. The measures were mainly made with a magnifying power of 460 diameters, but a power of 700 was frequently used when the distances were not too great and the atmosphere steady enough. In all the measures, to avoid parallax, the objects have been bisected in the center of the field by a quick adjustment of the eyepiece over the object.

The parallel to the equator was carefully determined at the point of observation. With this setting, the $\Delta\delta$ was measured; the wires were then revolved 90° in position angle and a set of $\Delta\delta$ obtained by direct measures. The micrometer was then revolved back through 90° and another set of $\Delta\delta$ secured. In the absence of a chronometer a good Howard watch was used for recording the observations. Its error was determined by comparison with the standard Howard clock of the Observatory. The time of each setting was recorded to the nearest second by the observer himself, who worked without any recorder.

The distances measured were limited to about 5′ by the construction of the micrometer. Knowing the desirability of securing measures with as many comparison stars as possible, the planet was connected with every star directly available and not too faint. In making the measures it was thought best to finish, say, the settings for $\Delta\alpha$ for each of the stars in turn before revolving the wires for the $\Delta\delta$. This was done as quickly as possible with due reference to accuracy. The $\Delta\delta$ was then measured for all the stars, and the micrometer turned back again for the $\Delta\alpha$. Though, by this method, the observations were not strictly symmetrical in some cases, it is thought that the additional advantage of so many comparison stars observed at the same time will more than balance this. The parallel was carefully determined several times each night, both at the point of observation and at the equator near the meridian.

The coincidence of the micrometer threads remained constant with scarcely any perceptible

change throughout the observations. The wires of the micrometer were frequently examined, to see that they were parallel to each other, and in the measures they were frequently interchanged, thus to a certain extent producing the effect of double distances.

It was necessary frequently to use very small comparison stars, because no others were within reach of the micrometer. After *Eros* passed from the Milky Way, the presence of considerable stars in the field became quite rare. Early notification of this fact was sent to Paris, and it is assumed that the photographic plates will contain the comparison stars down to at least the $12\frac{1}{2}$ magnitude. In some cases it was necessary to use 13m stars.

The corrections for refraction have been computed by Mr. H. A. Fischer, Jr. (who has also checked the reductions of the observations) from the formulæ

$$\Delta(a' - a) = s\chi\left[\tan^2\zeta\cos(p - q)\sin q + \sec u\sin(p - u)\right] , \tag{1}$$

$$\Delta(\delta' - \delta) = s\chi\left[\tan^2\zeta\cos(p - q)\cos q + \sec u\cos(p - u)\right] , \tag{2}$$

which are from Chauvenet's *Spherical and Practical Astronomy*. The original form of the first formula is multiplied by sec δ. This was omitted in the reductions to make the refraction correction in right ascension harmonious with the direct measures of Δa.

The refraction corrections were computed for a mean condition of the barometer without regard to the altitude of the Observatory (about 1,100 feet). The computations were then gone over, and where the error would amount to as much as $0\overset{s}{.}01$ a special refraction was computed.

Besides the computation of the refractions, Mr. Fischer has done much of the work of compilation, and has otherwise given the most efficient aid in all the work. His skill has aided in the detection and elimination of many errors in the reductions.

A list of barometer and thermometer readings is given farther on. The barometer is located on the wall of the hall at the east end of the main building, some three hundred feet from the large telescope. During the winter this part of the building is heated by steam to a temperature of 70° or 75°, which will account for the relatively high readings of the attached thermometer.

The barometer and thermometer are read by one of the night employees of the Observatory at 9 P. M., 1 A. M., and 4 A. M. No record of the barometer reading is kept by the observer, because of the above three readings each night. The observer, however, always keeps a record at frequent intervals during the night of the thermometers inside and outside the dome.

In nearly all the observations the seeing was poor, and at times very bad. It is not believed, however, that this will materially affect the results, as every precaution was taken to eliminate its effects. In general it meant that a longer time must be devoted to an observation. The major portion of the measures fall in the worst possible season here for observation.

The work was much interfered with by clouds. Every available chance was taken advantage of by the observer to secure frequent measures of the planet during the night, on account of the request that as many observations as possible should be obtained each night to eliminate the effects of clouds at other points. When this was known, the observer began at once to devote as much time as possible throughout the night to observations of the planet.

Altogether there are 1,506 sets of measures, each depending on an average of five settings of the wires; making in all about 7,500 individual settings of the micrometer wires. Each night a diagram of the field of view was made to insure identification of the comparison stars. Copies of all these have been sent to Paris. All of the observations have also been sent to Paris in manuscript.

During the winter of 1901–2 the position of the great telescope was carefully determined from numerous stars, with the following results:

North end of polar axis too low, 0′ 39″
North end of polar axis too far west, 0′ 45″

In the winter of 1897 the position was found to be:

North end of polar axis too low, $0' \ 10''$
North end of polar axis too far west, $1' \ 0''$

showing that the instrument has not materially changed its position in the past four or five years. The horizontal flexure of the tube has not yet been fully determined, though a number of observations have been made for this purpose. The results so far show it must be small. From this it will be seen that the position of the instrument itself can in no way seriously enter into the results as a sensible factor in the differential measures.

The following discordant observations have been noted:

1900, October 14: The observation at $17^h 10^m$ may be of a fixed star.

1900, October 17: The $\Delta\alpha$ at $11^h 49^m 11^s$ does not seem to be reconcilable with the comparison star. Possibly another star was used in this measure.

1900, October 26: $17^h 36^m 14^s$. Observation uncertain, on account of clouds.

1900, November 1: This measure is not understood. Question if right comparison star; also question if $\Delta\alpha$ or $\Delta\delta$.

1900, November 3: This is not *Eros*.

1900. November 4: The observation at $18^h 6^m 51^s$ may be of * 2 and an 11m star, instead of with *Eros* — there was such a star $1' \pm$ *np*. Same date, $17^h 57^m 37^s$. This observation may be uncertain. It does not reconcile closely with the others.

1900, November 26: $15^h 21^m 43^s$ and $16^h 10^m 16^s$. One of these measures seems to be wrong. The last one is perhaps correct.

1900, December 2: $5^h 42^m 29^s$. The $\Delta\delta$ alone was observed for this star.

1900, December 20: These measures made by glimpses through clouds and are an hour apart. It is questioned if they both refer to same star. A break in the clouds each time gave only a few moments' observation.

On January 16 the observation times are subject to some uncertainty. A half-hour after the last observation of *Eros*, while measuring the satellite of Neptune, the watch ran down from want of winding. No comparison had yet been made with the standard clock on that night. The watch had been keeping excellent time previous to this, and also after this date. It is believed the given times can be relied on to within 5^s or less for this date. The night afterward the watch was intentionally allowed to go without winding, and when almost run down its rate did not materially change, so that it is believed the observation times are closely correct; but, of course, there must be some uncertainty attached to them.

The following errors of the watch will, it is thought, give confidence in the close exactness of the observation times:

ERRORS OF THE WATCH, 1901, JANUARY

$8^d \ 8^h \ 30^m$	fast $0^m \ 43^s$	$16^d \ 9^h \ 5^m$	fast $1^m \ 21^s$
12 7 21	" 0 46	16 10 39	" 1 21
14 2 0	" 0 44	16 18 23	" 1 21
14 9 3	" 0 44½		
14 11 11	" 0 43½	17 6 4	" 1 19
14 17 23	" 0 42	17 7 32	" 1 19
16 7 40	watch ran down	17 8 59	" 1 18½
16 8 6	fast $1^m \ 20\frac{1}{2}^s$	17 11 6	" 1 19

MICROMETRICAL OBSERVATIONS OF *EROS*

Date—1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Oct. 2	8h 12m 5s	1	4	....	......	....	−0′ 16″73	+0″03	−0′ 16″70	....	+3″79
	8 16 19	2	4	....	......	....	+1 15.53	+0.03	+1 15.56	....	+3.71
	8 21 11	1	4	−0′ 51″05	−0″03	−0′ 51″08	....	......	....	−0s.613	......
	8 25 35	2	4	+0 5.70	+0.01	+0 5.71	....	......	....	−0.612	......
	8 33 33	1	5	....	......	....	+0 4.36	+0.03	+0 4.39	....	+3.36
	8 38 25	2	5	....	......	....	+1 36.99	+0.04	+1 37.03	....	+3.26
	8 50 8	8.6	5	....	......	....	−2 37.94	−0.05	−2 37.99	....	+3.03
	8 56 51	8.6	5	−0 9.49	+0.03	−0 9.46	....	......	....	−0.594	......
	9 3 22	8.6	5	....	......	....	−2 25.31	−0.05	−2 25.36	....	+2.76
	11 32 21	8.6	5	....	......	....	−0 2.95	0.00	−0 2.95	....	+0.37
	11 35 22	8.6	est.	....	......	....	0 0.00	0.00	0 0.00	....	+0.34
	11 39 0	8.6	5	−0 11.12	0.00	−0 11.12	....	......	....	−0.341	......
	11 45 9	8.6	6	....	......	....	+0 9.01	0.00	+0 9.01	....	+0.21
	11 52 33	8.6	6	−0 11.43	0.00	−0 11.43	....	......	....	−0.311	......
	16 46 38	12	6	+1 13.19	+0.03	+1 13.22	....	......	....	+0.425	......
	16 56 4	12	5	....	......	....	+0 15.25	+0.02	+0 15.27	....	+0.93
	17 4 18	12	5	+1 12.55	+0.02	+1 12.57	....	......	....	+0.458	......
Oct. 3	12 50 19	1	4	....	......	....	+0 23.66	+0.01	+0 23.67	....	−0.37
	12 55 13	2	4	....	......	....	−0 35.76	−0.01	−0 35.77	....	−0.39
	13 1 7	1	4	+0 2.62	0.00	+0 2.62	....	......	....	−0.130	......
	13 5 43	2	4	+0 15.63	0.00	+0 15.63	....	......	....	−0.119	......
	13 11 0	1	4	....	......	....	+0 53.91	+0.01	+0 53.92	....	−0.46
	13 18 7	2	5	....	......	....	−0 14.46	0.00	−0 14.46	....	−0.49
Oct. 4	11 59 3	10.3	5	....	......	....	−0 28.05	−0.01	−0 28.06	....	−0.07
	12 6 50	10.3	5	+0 23.61	+0.01	+0 23.62	....	......	....	−0.255	......
	12 13 6	10.3	5	....	......	....	−0 14.38	0.00	−0 14.38	....	−0.19
Oct. 8	7 27 23	1	5	....	......	....	−0 14.29	+0.06	−0 14.23	....	+4.02
	7 32 50	2	5	....	......	....	−0 21.80	−0.04	−0 21.84	....	+3.91
	7 41 23	1	6	−1 2.71	−0.06	−1 2.77	....	......	....	−0.639	......
	7 47 33	2	6	+0 32.97	+0.03	+0 33.00	....	......	....	−0.638	......
	7 54 13	1	5	....	......	....	+0 10.48	+0.05	+0 10.53	....	+3.45
	7 59 11	2	5	....	......	....	+0 2.64	−0.02	+0 2.62	....	+3.35
	8 5 37	1	6	−1 6.41	−0.05	−1 6.46	....	......	....	−0.632	......
	8 11 34	2	6	+0 29.76	+0.02	+0 29.78	....	......	....	−0.630	......
	8 32 56	B.D.	1	....	......	....	−4 32.01	−0.04	−4 32.05	....	+2.68
	12 36 25	B.D.	4	....	......	....	−0 51.22	0.00	−0 51.22	....	−0.66
	12 42 57	B.D.	5	−2 31.64	−0.05	−2 31.69	....	......	....	−0.125	......
	13 4 28	B.D.	6	....	......	....	−0 26.21	−0.01	−0 26.22	....	−0.75
	13 10 38	B.D.	4	−2 37.24	−0.05	−2 37.29	....	......	....	−0.047	......
	16 41 36	1	4	....	......	....	−0 7.05	−0.02	−0 7.07	....	+0.84
	16 45 42	2	4	....	......	....	−0 5.17	+0.01	−0 5.16	....	+0.91
	16 50 40	1	4	−1 12.34	−0.03	−1 12.37	....	......	....	+0.497	......
	16 54 29	2	4	+0 44.84	+0.02	+0 44.86	....	......	....	+0.504	......
	17 1 48	1	4	−1 14.49	−0.04	−1 14.53	....	......	....	+0.516	......
	17 5 8	2	4	+0 42.94	+0.02	+0 42.96	....	......	....	+0.522	......
	17 9 44	9.8	5	−0 59.63	0.00	−0 59.63	....	......	....	+0.529	......
	17 15 4	9.8	5	....	......	....	−1 56.49	−0.05	−1 56.54	....	+1.43
	17 20 49	9.8	5	....	......	....	−1 51.43	−0.05	−1 51.48	....	+1.50
	17 26 37	9.8	5	−1 2.65	−0.01	−1 2.66	....	......	....	+0.555	......
	17 31 37	9.8	5	−1 3.55	−0.01	−1 3.56	....	......	....	+0.562	......
	17 36 51	9.8	5	....	......	....	−1 37.93	−0.05	−1 37.98	....	+1.79
Oct. 9	7 15 30	1	6	....	......	....	+0 1.56	−0.04	+0 1.52	....	+4.15
	7 22 49	2	5	....	......	....	−0 33.84	+0.02	−0 33.82	....	+4.00
	7 30 29	1	6	+0 45.03	+0.04	+0 45.07	....	......	....	−0.646	......
	7 35 33	2	6	−0 44.34	−0.04	−0 44.38	....	......	....	−0.646	......
	7 42 33	1	6	....	......	....	+0 26.21	−0.02	+0 26.19	....	+3.58
	7 47 57	2	6	....	......	....	−0 10.72	+0.03	−0 10.69	....	+3.48
	7 53 35	1	6	+0 41.01	+0.04	+0 41.05	....	......	....	−0.641	......
	8 0 7	2	7	−0 48.70	−0.04	−0 48.74	....	......	....	−0.639	......
	8 32 20	1	5	....	......	....	+1 11.76	+0.01	+1 11.77	....	+2.55
	8 36 39	3	5	....	......	....	−0 51.43	−0.02	−0 51.45	....	+2.47
	8 42 24	3	5	+0 2.79	−0.01	+0 2.78	....	......	....	−0.610	......
	8 47 39	1	5	+0 31.82	+0.03	+0 31.85	....	......	....	−0.605	......
	14 11 12	9	6	....	......	....	−0 1.66	0.00	−0 1.66	....	−0.76
	14 15 53	9	4	....	......	....	+0 2.59	0.00	+0 2.59	....	−0.74
	14 20 42	9	5	−1 20.76	−0.02	−1 20.78	....	......	....	+0.159	......
	14 26 53	9	5	....	......	....	+0 12.05	0.00	+0 12.05	....	−0.68

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Oct. 9 11h 32m 39	9	5	−1′ 23″.04	−0″.03	−1′ 23″.07	......	......	......	+0s.192	......
16 19 41	1	5	......	......	......	+0′ 31″.33	0″.00	+0′ 31″.33	......	+0″.51
16 26 20	1	5	−0 33.90	−0.02	−0 33.92	......	......	......	+0.465	......
16 32 0	1	5	......	......	......	+0 41.58	0.00	+0 41.58	......	+0.68
16 38 51	1	5	−0 36.61	−0.02	−0 36.63	......	......	......	+0.488	......
16 51 25	2	5	+0 25.45	+0.03	+0 25.48	......	......	......	+0.516	......
17 2 39	2	8	......	......	......	−1 44.16	−0.03	−1 44.19	......	+1.20
17 13 56	1	5	......	......	......	+1 16.98	+0.01	+1 16.99	......	+1.39
17 18 46	2	5	......	......	......	−1 30.45	−0.02	−1 30.47	......	+1.48
17 23 49	2	5	+0 19.39	+0.03	+0 19.42	......	......	......	+0.561	......
17 27 55	1	5	−0 46.82	−0.04	−0 46.86	......	......	......	+0.567	......
17 32 15	2	4	+0 17.37	+0.03	+0 17.40	......	......	......	+0.574	......
17 35 58	1	4	−0 48.49	−0.04	−0 48.53	......	......	......	+0.578	......
17 41 0	2	5	......	......	......	−1 12.04	−0.02	−1 12.06	......	+1.87
Oct. 10 12 49 59	12.7	4	......	......	......	+0 45.58	+0.01	+0 45.59	......	−0.87
12 55 42	12.7	4	+2 19.73	+0.04	+2 19.77	......	......	......	−0.062	......
13 2 29	12.7	4	......	......	......	+0 56.01	+0.01	+0 56.02	......	−0.90
Oct. 11 6 44 16	1	5	......	......	......	+0 6.23	−0.17	+0 6.06	......	+4.58
6 49 24	1	5	+2 45.61	+0.17	+2 45.78	......	......	......	−0.649	......
7 1 10	2	4	−1 58.67	−0.11	−1 58.78	......	......	......	−0.652	......
7 5 44	2	4	......	......	......	−0 50.49	+0.08	−0 50.41	......	+4.13
7 9 36	2	4	......	......	......	−0 46.89	+0.08	−0 46.81	......	+4.05
7 25 48	1	5	+2 37.75	+0.13	+2 37.88	......	......	......	−0.653	......
7 30 8	2	5	−2 4.92	−0.10	−2 5.02	......	......	......	−0.652	......
7 34 56	2	5	......	......	......	−0 24.62	+0.08	−0 24.54	......	+3.52
7 38 41	1	5	......	......	......	+0 54.55	−0.08	+0 54.47	......	+3.44
7 50 11	1	6	+2 32.43	+0.12	+2 32.55	......	......	......	−0.646	......
7 54 50	2	5	−2 10.56	−0.10	−2 10.66	......	......	......	−0.645	......
8 0 57	1	5	......	......	......	+1 14.38	−0.06	+1 14.32	......	+2.97
8 4 51	2	5	......	......	......	+0 2.46	+0.08	+0 2.54	......	+2.89
13 47 57	1	4	......	......	......	−0 25.31	0.00	−0 25.31	......	−0.90
13 53 3	2	4	......	......	......	+1 10.24	+0.02	+1 10.26	......	−0.88
13 59 1	1	4	+0 46.69	+0.01	+0 46.70	......	......	......	+0.125	......
14 7 18	2	4	−1 30.76	−0.03	−1 30.79	......	......	......	+0.150	......
16 32 10	1	4	......	......	......	−1 55.56	−0.02	−1 55.58	......	+0.77
16 35 31	2	4	......	......	......	+1 53.16	+0.03	+1 53.19	......	+0.82
16 40 55	1	4	+0 28.89	+0.03	+0 28.92	......	......	......	+0.513	......
16 46 5	2	5	+0 0.66	−0.02	+0 0.64	......	......	......	+0.522	......
16 51 48	1	4	......	......	......	−1 39.65	−0.02	−1 39.67	......	+1.10
16 55 51	2	4	......	......	......	+2 9.73	+0.04	+2 9.77	......	+1.16
17 4 45	1	4	+0 22.72	+0.03	+0 22.75	......	......	......	+0.552	......
17 9 1	2	4	−0 5.48	−0.03	−0 5.51	......	......	......	+0.558	......
17 13 53	1	4	......	......	......	−1 21.69	−0.02	−1 21.71	......	+1.49
17 17 32	2	4	......	......	......	+2 27.23	+0.04	+2 27.27	......	+1.56
17 23 2	1	4	+0 17.97	+0.03	+0 18.00	......	......	......	+0.579	......
17 26 36	2	4	−0 10.03	−0.04	−0 10.07	......	......	......	+0.584	......
17 31 37	1	4	......	......	......	−1 7.41	−0.03	−1 7.41	......	+1.82
Oct. 14 7 17 43	1	4	......	......	......	+0 27.61	+0.05	+0 27.66	......	+3.49
7 21 40	2	4	......	......	......	−2 53.37	−0.08	−2 53.45	......	+3.40
7 26 27	1	4	−1 2.12	−0.05	−1 2.17	......	......	......	−0.665	......
7 29 27	2	4	+0 12.86	−0.02	+0 12.84	......	......	......	−0.664	......
7 32 6	2	4	+0 12.14	−0.02	+0 12.12	......	......	......	−0.663	......
7 34 51	1	4	−1 4.82	−0.04	−1 4.86	......	......	......	−0.662	......
16 57 54	1	5	......	......	......	−1 38.08	−0.04	−1 38.12	......	+1.32
17 3 12	2	5	......	......	......	+1 22.26	+0.05	+1 22.31	......	+1.41
17 9 38	2	5	+0 14.67	......	......	......	......	......	+0.593	......
17 14 33	2	5	+1 4.21	+0.01	+1 4.25	......	......	......	+0.599	......
17 23 27	1	4	......	......	......	−1 18.50	−0.04	−1 18.54	......	+1.83
17 28 32	2	4	......	......	......	+1 41.67	+0.06	+1 41.73	......	+1.92
17 34 47	1	4	−0 49.54	−0.01	−0 49.55	......	......	......	+0.623	......
17 40 1	2	4	+0 55.53	+0.01	+0 55.54	......	......	......	+0.629	......
17 45 44	2	3	......	......	......	+1 54.35	+0.06	+1 51.41	......	+2.26
Oct. 15 6 41 51	1	5	......	......	......	+0 56.30	+0.04	+0 56.34	......	+4.14
6 45 35	2	4	......	......	......	+1 31.33	+0.11	+1 31.44	......	+4.05
6 50 28	2	4	......	......	......	+1 35.23	+0.11	+1 35.31	......	+3.95
6 55 16	1	5	−0 7.39	0.00	−0 7.39	......	......	......	−0.672	......
7 0 52	2	5	−1 11.35	−0.05	−1 11.40	......	......	......	−0.672	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Oct.15 7h 8m 4s	1	4	....	......	....	+1′ 18.′′02	+0.′′04	+1′ 18.′′06	....	+3.′′58
7 12 30	2	4	....	......	....	+1 54.35	+0.10	+1 54.45	....	+3.47
7 18 23	2	5	−1′ 17.′′22	−0.′′04	−1′ 17.′′26	....	......	....	−0.s669	......
7 22 15	1	5	−0 16.33	+0.01	−0 16.32	....	......	....	−0.668	......
Oct.16 6 38 8	1	5	....	......	....	+0 37.77	+0.06	+0 37.83	....	+4.12
6 42 42	2	5	....	......	....	−1 23.80	0.00	−1 23.80	....	+4.01
6 47 51	1	5	+1 32.42	+0.09	+1 32.51	....	......	....	−0.675	......
6 51 58	2	5	−0 54.12	−0.06	−0 54.18	....	......	....	−0.675	......
6 56 34	2	5	−0 55.87	−0.06	−0 55.93	....	......	....	−0.675	......
7 0 34	1	5	+1 28.14	+0.08	+1 28.22	....	......	....	−0.675	......
7 5 6	3	5	+1 2.98	+0.05	+1 3.03	....	......	....	−0.675	......
7 10 45	3	5	....	......	....	−0 27.07	−0.06	−0 27.13	....	+3.40
7 15 55	1	5	....	......	....	+1 8.81	−0.03	+1 8.78	....	+3.30
7 20 25	2	5	....	......	....	−0 52.83	+0.02	−0 52.81	....	+3.21
7 25 0	2	5	−1 6.07	−0.06	−1 6.13	....	......	....	−0.669	......
7 29 37	3	5	+0 53.66	+0.04	−0 53.70	....	......	....	−0.667	......
7 33 45	1	5	+1 15.91	+0.07	+1 15.98	....	......	....	−0.664	......
12 30 30	7.5	5	....	......	....	−1 51.11	−0.03	−1 51.14	....	−1.17
12 36 28	7.5	5	+0 27.06	+0.01	+0 27.07	....	......	....	−0.044	......
12 50 24	7.5	4	+0 21.16	+0.01	+0 21.17	....	......	....	−0.006	......
12 56 24	7.5	6	....	......	....	−1 31.52	−0.03	−1 31.55	....	−1.19
16 40 15	1	5	....	......	....	+1 15.54	0.00	+1 15.54	....	+1.10
16 45 38	1	5	−1 17.52	−0.06	−1 17.58	....	......	....	+0.578	......
16 50 4	2	5	+0 33.21	0.00	+0 33.21	....	......	....	+0.584	......
16 55 48	2	6	....	......	....	+2 12.48	+0.05	+2 12.53	....	+1.39
17 7 25	1	5	....	......	....	+1 35.32	0.00	+1 35.32	....	+1.61
17 13 4	1	5	−1 28.58	−0.07	−1 28.65	....	......	....	+0.615	......
17 17 54	2	5	+0 22.02	−0.03	+0 21.99	....	......	....	+0.620	......
17 23 28	2	5	....	......	....	+2 32.63	+0.06	+2 32.69	....	+1.92
17 27 15	1	5	....	......	....	+1 49.71	−0.01	+1 49.70	....	+2.01
17 35 54	2	5	+0 15.29	−0.03	+0 15.26	....	......	....	+0.639	......
17 40 58	1	5	−1 39.37	−0.09	−1 39.46	....	......	....	+0.642	......
17 50 27	1	3	−1 42.96	−0.10	−1 43.06	....	......	....	+0.651	......
Oct.17 7 9 23	10.5	2	....	......	....	−0 1.48	−0.14	−0 1.62	....	+3.28
7 11 3	10.5	est.	....	......	....	0 0.00	−0.14	−0 0.14	....	+3.24
7 13 39	10.5	3	....	......	....	+0 2.25	−0.13	+0 2.12	....	+3.18
7 18 6	10.5	5	+3 11.53	+0.14	+3 11.67	....	......	....	−0.675	......
7 24 56	10.5	4	+3 8.58	+0.14	+3 8.72	....	......	....	−0.671	......
7 30 36	10.5	5	....	......	....	+0 15.58	−0.10	+0 15.48	....	+2.80
11 41 39	10	4	....	......	....	−3 13.29	−0.06	−3 13.35	....	−1.05
11 49 11	10	4	−0 37.36	......	....	....	......	....	−0.167	......
11 53 29	10	3	....	......	....	−3 3.89	−0.05	−3 3.94	....	−1.11
11 57 26	10	3	−0 9.19	−0.01	−0 9.20	....	......	....	−0.145	......
16 56 33	1	6	....	......	....	−0 58.76	+0.03	−0 58.73	....	+1.49
17 2 46	2	6	....	......	....	+0 41.61	−0.06	+0 41.55	....	+1.61
17 9 40	1	5	+2 2.12	+0.07	+2 2.19	....	......	....	+0.622	......
17 17 44	2	6	−3 3.43	−0.11	−3 3.54	....	......	....	+0.633	......
17 25 6	1	8	+1 55.04	+0.08	+1 55.12	....	......	....	+0.639	......
17 31 31	2	5	−3 9.28	−0.13	−3 9.41	....	......	....	+0.645	......
17 36 39	1	6	....	......	....	−0 30.12	+0.05	−0 30.07	....	+2.30
17 41 33	2	3	....	......	....	+1 8.52	−0.08	+1 8.44	....	+2.41
17 46 22	1	5	+1 46.03	+0.08	+1 46.11	....	......	....	+0.658	......
Oct.18 16 3 5	9.2	5	....	......	....	+3 42.21	+0.10	+3 42.31	....	+0.56
16 10 29	9.2	5	+2 14.59	+0.01	+2 14.60	....	......	....	+0.544	......
16 17 14	9.2	5	....	......	....	+3 51.53	+0.10	+3 51.63	....	+0.80
Oct.25 6 18 50	1	4	....	......	....	+1 31.31	−0.02	+1 31.29	....	+3.30
6 24 7	1	4	+1 16.62	+0.08	+1 16.70	....	......	....	−0.710	......
6 29 17	1	4	+1 13.37	+0.08	+1 13.45	....	......	....	−0.709	......
6 34 4	1	4	....	......	....	+1 40.39	−0.01	+1 40.38	....	+2.94
6 40 30	2	5	....	......	....	−1 34.56	+0.07	−1 34.49	....	+2.80
6 46 4	2	5	−4 2.77	−0.19	−4 2.96	....	......	....	−0.701	......
6 52 28	2	4	−4 6.66	−0.19	−4 6.85	....	......	....	−0.699	......
6 57 19	2	4	....	......	....	−1 24.50	+0.07	−1 24.43	....	+2.43
7 45 53	1	5	....	......	....	+2 23.89	+0.04	+2 23.93	....	+1.41
7 52 32	1	5	+0 22.50	+0.05	+0 22.55	....	......	....	−0.637	......
11 31 51	1	5	....	......	....	−2 24.79	−0.04	−2 24.83	....	−1.52
11 39 9	1	4	+1 18.12	+0.02	+1 18.14	....	......	....	−0.078	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90 Time	Comp. Star	No. Obs.	Measured $\Delta\alpha$	Ref.	Corrected $\Delta\alpha$	Measured $\Delta\delta$	Ref.	Corrected $\Delta\delta$	Parallax Factors $\Delta\alpha$	Parallax Factors $\Delta\delta$
Oct.25 11^h 45^m 21^s	1	4	....	......	....	−2′ 17″.52	−0″.04	−2′ 17″.56	....	−1″.55
16 31 53	1	5	....	......	....	+0 11.91	0.00	+0 11.91	....	+1.58
16 38 51	2	5	....	......	....	−0 49.04	+0.05	−0 48.99	....	+1.72
16 46 1	2	5	+2 34^s.81	+0^s.10	+2 34^s.91	....	......	....	+0^s.674	......
16 54 6	1	5	−2 6.34	−0.08	−2 6.42	....	......	....	+0.682	......
17 10 38	1	5	....	......	....	+0 31.33	−0.08	+0 31.25	....	+2.45
17 17 5	2	5	....	......	....	−0 30.35	+0.07	−0 30.28	....	+2.56
17 24 41	2	5	+2 10.72	+0.10	+2 10.82	....	......	....	+0.704	......
17 29 55	1	5	−2 28.35	−0.11	−2 28.46	....	......	....	+0.706	......
17 38 38	1	6	....	......	....	+0 44.89	−0.11	+0 44.78	....	+3.03
17 44 43	2	6	....	......	....	−0 16.73	+0.08	−0 16.65	....	+3.16
17 51 4	2	4	+1 54.60	+0.09	+1 54.69	....	......	....	+0.712	......
Oct.26 5 55 45	1	5	....	......	....	−2 0.37	−0.12	−2 0.49	....	+3.69
6 1 18	1	5	+1 28.04	+0.03	+1 28.07	....	......	....	−0.716	......
6 7 47	1	5	....	......	....	−1 53.41	−0.11	−1 53.52	....	+3.42
6 14 10	2	5	....	......	....	+0 30.35	+0.18	+0 30.53	....	+3.26
6 21 8	1	5	+1 15.93	+0.01	+1 15.94	....	......	....	−0.713	......
6 27 9	2	5	−4 12.30	−0.17	−4 12.47	....	......	....	−0.711	......
7 38 2	1	5	....	......	....	−1 1.24	−0.03	−1 1.27	....	+1.43
7 44 30	1	5	+0 23.10	−0.01	+0 23.09	....	......	....	−0.644	......
7 48 40	1	5	+0 20.49	−0.01	+0 20.48	....	......	....	−0.639	......
7 53 22	1	5	....	......	....	−0 52.62	−0.02	−0 52.64	....	+1.13
9 0 2	1	5	....	......	....	−0 15.18	0.00	−0 15.18	....	−0.10
9 3 49	1	5	−0 28.81	−0.01	−0 28.82	....	......	....	−0.497	......
11 56 26	1	5	....	......	....	+1 20.30	+0.02	+1 20.32	....	−1.59
12 1 51	1	5	−2 29.04	−0.04	−2 29.08	....	......	....	+0.006	......
12 7 32	1	4	−2 32.70	−0.04	−2 32.74	....	......	....	+0.025	......
12 11 35	1	4	....	......	....	+1 28.33	+0.03	+1 28.36	....	−1.58
16 25 7	1	4	....	......	....	+0 27.61	0.00	+0 27.61	....	+1.54
16 30 15	2	4	....	......	....	−0 31.67	−0.06	−0 31.73	....	+1.64
16 35 3	3	4	....	......	....	−1 43.14	−0.03	−1 43.17	....	+1.75
16 41 41	3	4	−0 8.76	+0.02	−0 8.74	....	......	....	+0.676	......
16 46 3	1	4	−0 37.71	−0.03	−0 37.74	....	......	....	+0.681	......
16 50 49	2	4	−2 10.24	−0.07	−2 10.31	....	......	....	+0.685	......
17 2 35	3	4	....	......	....	−1 30.72	−0.03	−1 30.75	....	+2.33
17 7 59	2	4	....	......	....	−0 14.66	−0.07	−0 14.73	....	+2.44
17 36 14	1	3	....	......	....	+1 0.44	+0.01	+1 0.45	....	+3.08
Oct.27 9 7 29	1	5	....	......	....	−1 56.21	−0.03	−1 56.24	....	−0.39
9 14 13	1	5	−0 14.56	−0.03	−0 14.59	....	......	....	−0.451	......
9 25 38	1	4	....	......	....	−1 46.80	−0.03	−1 46.83	....	−0.64
9 30 0	1	4	−0 25.16	−0.03	−0 25.19	....	......	....	−0.413	......
9 34 11	2	4	+0 45.26	+0.03	+0 45.29	....	......	....	−0.400	......
9 37 57	2	4	....	......	....	+1 9.09	+0.01	+1 9.10	....	−0.79
9 43 8	2	4	+0 39.32	+0.02	+0 39.34	....	......	....	−0.379	......
9 47 29	2	4	....	......	....	+1 13.58	+0.02	+1 13.60	....	−0.91
Oct.30 15 52 1	11	5	....	......	....	+1 6.02	+0.05	+1 6.07	....	+1.25
15 59 18	11	5	+1 10.47	+0.02	+1 10.49	....	......	....	+0.667	......
16 12 23	11	4	....	......	....	+1 13.39	+0.05	+1 13.44	....	+1.71
Nov.1 5 55 12	1	4	....	......	....	−0 25.82	+0.02	−0 25.80	....	+2.84
5 58 46	1	4	−0 42.59	−0.04	−0 42.63	....	......	....	−0.725	......
6 2 21	2	5	+0 26.48	+0.01	+0 26.52	....	......	....	−0.724	......
6 6 28	3	5	+0 10.69	+0.03	+0 10.72	....	......	....	−0.721	......
6 10 14	3	5	+0 7.85	+0.03	+0 7.88	....	......	....	−0.719	......
6 13 46	2	5	+0 18.34	+0.04	+0 18.38	....	......	....	−0.717	......
6 17 37	2	5	....	......	....	+1 30.22	+0.02	+1 30.21	....	+2.32
6 21 32	3	5	....	......	....	−1 54.22	......	....	....	+2.12
6 30 37	1	5	....	......	....	−0 12.89	+0.02	−0 12.87	....	+2.03
6 36 46	4	5	....	......	....	+3 44.51	+0.07	+3 44.58	....	+1.90
6 42 40	4	5	−0 5.49	+0.07	−0 5.42	....	......	....	−0.692	......
6 51 11	4	5	−0 11.96	+0.06	−0 11.90	....	......	....	−0.683	......
6 56 34	4	5	....	......	....	+3 51.84	+0.08	+3 51.92	....	+1.47
8 10 40	1	5	....	......	....	+0 23.45	+0.04	+0 23.49	....	0.00
8 15 32	3	5	....	......	....	+2 13.17	+0.06	+2 13.23	....	−0.05
8 20 22	2	5	....	......	....	−1 10.91	+0.01	+1 10.90	....	−0.10
8 26 7	1	5	−2 32.02	−0.05	−2 32.07	....	......	....	−0.519	......
8 31 8	3	5	−1 24.59	0.00	−1 24.59	....	......	....	−0.507	......
8 35 51	2	5	−1 41.02	−0.05	−1 41.07	....	......	....	−0.495	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Nov. 1	8h 43m 44s	1	4	−2′ 45″.47	−0″.05	−2′ 45″.52	....	......	....	−0s.476	......
	8 47 49	3	4	−1 37.28	0.00	−1 37.28	....	......	....	−0.466	......
	8 50 55	2	4	−1 52.15	−0.05	−1 52.20	....	......	....	−0.453	......
	8 54 29	1	4	....	......	....	+0′ 38″.53	+0″.05	+0′ 38″.58	....	−0″.65
	8 57 17	3	4	....	......	....	+2 28.09	+0.06	+2 28.15	....	−0.69
	9 0 21	2	4	....	......	....	−0 57.25	0.00	−0 57.25	....	−0.73
	16 46 42	1	5	....	......	....	−1 25.00	−0.13	−1 25.13	....	+2.65
	16 51 45	2	5	....	......	....	+2 39.92	+0.01	+2 39.93	....	+2.76
	16 58 49	1	5	−2 50.09	−0.10	−2 50.19	....	......	....	+0.728	......
	17 5 10	2	5	−1 42.32	−0.12	−1 42.44	....	......	....	+0.730	......
	17 12 38	1	5	....	......	....	−1 18.52	−0.17	−1 18.69	....	+3.24
	17 17 48	2	5	....	......	....	+2 46.31	−0.02	+2 46.32	....	+3.36
	17 30 17	1	5	−3 12.61	−0.14	−3 12.75	....	......	....	+0.733	......
	17 35 34	2	5	−2 8.14	−0.15	−2 8.29	....	......	....	+0.732	......
	17 49 53	3	6	+1 45.06	+0.10	+1 45.16	....	......	....	+0.728	......
	17 56 9	3	6	....	......	....	−0 18.12	+0.10	−0 18.02	....	+4.22
	18 1 29	3	6	+1 36.93	+0.09	+1 37.02	....	......	....	+0.723	......
Nov. 2	5 42 43	1	6	....	......	....	−0 1.56	−0.03	−0 1.59	....	+2.95
	5 47 35	1	6	+0 43.86	+0.03	+0 43.89	....	......	....	−0.731	......
	5 51 33	1	4	+0 40.94	+0.03	+0 40.93	....	......	....	−0.729	......
	5 55 10	2	5	−0 39.14	−0.03	−0 39.17	....	......	....	−0.727	......
	5 59 5	1	5	....	......	....	+0 3.85	−0.02	+0 3.83	....	+2.59
	6 2 51	2	4	....	......	....	−0 0.77	+0.03	−0 0.74	....	+2.54
	6 9 7	1	5	+0 28.03	+0.02	+0 28.05	....	......	....	−0.720	......
	6 12 55	1	5	+0 25.12	+0.02	+0 25.14	....	......	....	−0.717	......
	6 16 12	1	4	....	......	....	+0 9.63	−0.01	+0 9.62	....	+2.21
	6 18 42	1	4	....	......	....	+0 10.49	−0.01	+0 10.48	....	+2.14
	6 27 19	3	6	....	......	....	+2 14.91	+0.02	+2 14.93	....	+1.97
	6 31 43	3	5	....	......	....	+2 16.39	+0.02	+2 16.41	....	+1.86
	6 35 52	3	5	+0 47.73	+0.07	+0 47.80	....	......	....	−0.696	......
	6 39 2	3	5	+0 45.29	+0.07	+0 45.36	....	......	....	−0.693	......
	8 9 22	1	5	....	......	....	+0 46.68	+0.03	+0 46.71	....	−0.05
	8 13 44	3	5	....	......	....	+2 49.20	+0.07	+2 49.27	....	−0.13
	8 18 42	1	5	−1 10.39	−0.02	−1 10.41	....	......	....	−0.523	......
	8 23 16	3	5	−0 34.95	+0.04	−0 34.91	....	......	....	−0.514	......
	8 27 50	3	5	−0 38.45	+0.04	−0 38.41	....	......	....	−0.502	......
	8 31 37	1	5	−1 19.95	−0.02	−1 19.97	....	......	....	−0.492	......
	8 41 3	4	4	....	......	....	+1 51.21	+0.02	+1 51.23	....	−0.54
	8 44 33	4	4	+1 37.03	+0.06	+1 37.09	....	......	....	−0.460	......
	12 17 3	1	5	+2 4.52	+0.05	+2 4.57	....	......	....	+0.187	......
	12 24 8	2	5	+2 45.61	+0.05	+2 45.66	....	......	....	+0.006	......
	12 31 15	1	5	....	......	....	−1 36.33	−0.02	−1 36.35	....	−1.51
	12 35 53	2	5	....	......	....	−0 32.12	0.00	−0 32.12	....	−1.47
	12 39 46	2	5	....	......	....	−0 31.14	+0.01	−0 31.13	....	−1.44
	12 43 43	1	5	....	......	....	−1 33.23	−0.02	−1 33.25	....	−1.41
	12 55 0	1	5	+1 35.18	+0.04	+1 35.22	....	......	....	+0.299	......
	12 58 49	2	5	+2 17.96	+0.05	+2 18.01	....	......	....	+0.311	......
	16 56 7	1	5	....	......	....	−0 37.88	−0.08	−0 37.96	....	+2.98
	17 0 42	2	5	....	......	....	+0 26.55	−0.02	+0 26.53	....	+3.09
	17 4 41	3	4	....	......	....	−1 8.23	+0.01	−1 8.22	....	+3.17
	17 10 52	1	5	−1 40.54	−0.07	−1 40.61	....	......	....	+0.736	......
	17 15 23	2	5	−0 57.98	−0.05	−0 58.03	....	......	....	+0.736	......
	17 19 46	3	5	+0 53.26	+0.06	+0 53.32	....	......	....	+0.736	......
	17 23 54	3	5	+0 50.22	+0.06	+0 50.28	....	......	....	+0.736	......
	17 28 1	2	5	−1 7.19	−0.06	−1 7.25	....	......	....	+0.736	......
	17 31 31	1	5	−1 56.05	−0.09	−1 56.14	....	......	....	+0.735	......
	17 35 20	1	5	....	......	....	−0 29.88	−0.12	−0 30.00	....	+3.87
	17 38 38	2	6	....	......	....	+0 33.97	−0.05	+0 33.92	....	+3.96
	17 42 35	3	7	....	......	....	−1 0.64	+0.02	−1 0.62	....	+4.05
	17 47 23	3	4	+0 59.77	+0.06	+0 59.83	....	......	....	+0.730	......
	17 50 29	2	4	....	......	....	+0 35.99	−0.06	+0 35.93	....	+4.24
	17 55 18	1	7	....	......	....	−0 25.90	−0.14	−0 26.04	....	+4.32
	18 4 24	2	4	....	......	....	+0 39.02	−0.07	+0 38.95	....	+4.47
	18 8 0	2	4	−1 36.71	−0.10	−1 36.81	....	......	....	+0.719	......
Nov. 3	5 39 59	1	6	−0 2.97	+0.01	−0 2.96	....	......	....	−0.733	......
	5 44 31	1	6	−0 6.17	+0.01	−0 6.16	....	......	....	−0.731	......
	5 49 9	1	5	....	......	....	+0 38.91	+0.02	+0 38.93	....	+2.68
	5 52 5	1	5	....	......	....	+0 39.91	+0.02	+0 39.93	....	+2.61
	5 57 37	2	6	....	......	....	−2 4.04	+0.07	−2 3.97	....	+2.46

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Nov. 3 6h 2m 27s	2	6	......	......	......	−2′ 2″.57	+0″.06	−2′ 2″.51	......	+2″.37
6 7 14	2	6	−0′ 14″.45	−0″.08	−0 14″.53	......	......	......	−0s.717	......
6 11 37	2	6	−0 17.52	−0.08	−0 17.60	......	......	......	−0.714	......
6 16 46	1	5	−0 30.38	0.00	−0 30.38	......	......	......	−0.709	......
6 20 21	1	5	−0 32.77	−0.01	−0 32.78	......	......	......	−0.706	......
6 24 48	1	4	......	......	......	+0 49.40	+0.03	+0 49.43	......	+1.87
6 28 7	1	4	......	......	......	+0 50.52	+0.03	+0 50.55	......	+1.81
7 34 28	1	5	......	......	......	+1 9.55	+0.04	+1 9.59	......	+1.68
7 38 10	2	5	......	......	......	−1 35.27	0.00	−1 35.27	......	+1.59
7 43 5	1	5	......	......	......	+1 11.85	+0.04	+1 11.89	......	+1.48
7 46 56	2	5	......	......	......	−1 32.56	0.00	−1 32.56	......	+1.40
7 52 10	1	5	−1 43.67	−0.02	−1 43.69	......	......	......	−0.564	......
7 55 57	2	5	−1 37.35	−0.06	−1 37.41	......	......	......	−0.561	......
8 0 50	1	5	......	......	......	+1 50.39	+0.04	+1 50.43	......	+1.11
8 4 41	2	5	−1 44.35	−0.06	−1 44.41	......	......	......	−0.542	......
8 20 15	1	5	......	......	......	+1 22.09	+0.05	+1 22.14	......	+0.73
8 23 56	2	5	......	......	......	−1 22.74	0.00	−1 22.74	......	+0.65
8 28 36	1	5	−2 12.32	−0.03	−2 12.35	......	......	......	−0.486	......
8 32 35	2	5	−2 6.30	−0.06	−2 6.36	......	......	......	−0.476	......
10 52 46	10	5	......	......	......	−1 59.16	−0.03	−1 59.19	......	−1.76
10 59 17	10	5	......	......	......	−1 57.64	−0.03	−1 57.67	......	−1.77
11 5 32	10	5	−1 12.89	−0.02	−1 12.91	......	......	......	−0.022	......
11 10 56	10	5	−1 17.72	−0.02	−1 17.71	......	......	......	−0.006	......
11 18 34	9.5	5	−4 18.67	−0.08	−4 18.75	......	......	......	+0.019	......
11 31 43	9.5	3	......	......	......	+0 35.38	+0.01	+0 35.39	......	−1.76
16 18 15	1	5	......	......	......	−1 34.16	−0.02	−1 34.18	......	+2.24
16 23 14	2	5	......	......	......	−1 8.82	+0.08	−1 8.74	......	+2.35
16 29 15	1	6	+0 2.85	+0.03	+0 2.88	......	......	......	+0.725	......
16 35 22	2	5	+2 46.76	+0.13	+2 46.89	......	......	......	+0.728	......
16 40 11	1	5	−0 5.19	+0.02	−0 5.17	......	......	......	+0.730	......
16 45 45	2	5	+2 39.22	+0.13	+2 39.35	......	......	......	+0.733	......
16 58 56	1	5	......	......	......	−1 27.66	−0.05	−1 27.71	......	+3.17
17 3 0	2	5	......	......	......	−1 2.24	+0.09	−1 2.15	......	+3.26
17 17 34	3	5	......	......	......	+1 47.91	+0.12	+1 48.03	......	+3.61
17 21 30	1	5	......	......	......	−1 23.89	−0.07	−1 23.96	......	+3.68
17 24 57	2	5	......	......	......	−0 58.71	+0.09	−0 58.62	......	+3.77
17 30 35	1	5	−0 42.36	−0.02	−0 42.38	......	......	......	+0.735	......
17 35 9	3	5	+1 5.09	+0.04	+1 5.13	......	......	......	+0.734	......
17 39 28	2	5	+1 59.70	+0.12	+1 59.82	......	......	......	+0.732	......
17 45 13	2	3	+1 55.16	+0.11	+1 55.27	......	......	......	+0.730	......
17 47 37	1	3	−0 54.48	−0.04	−0 54.52	......	......	......	+0.728	......
17 50 39	3	4	+0 53.74	+0.03	+0 53.77	......	......	......	+0.727	......
17 54 1	3	3	......	......	......	+1 53.69	+0.12	+1 53.81	......	+4.43
17 56 44	1	3	......	......	......	−1 18.20	−0.12	−1 18.32	......	+4.49
17 59 49	2	4	......	......	......	−0 53.09	+0.08	−0 53.01	......	+4.56
18 3 51	2	4	+1 41.71	+0.10	+1 41.81	......	......	......	+0.718	......
18 6 36	1	3	−1 8.31	−0.06	−1 8.37	......	......	......	+0.716	......
Nov. 4 6 2 45	1	5	......	......	......	−0 30.09	+0.06	−0 30.03	......	+2.21
6 6 40	2	5	......	......	......	−1 4.12	+0.06	−1 4.06	......	+2.12
6 11 7	1	6	−2 9.21	−0.09	−2 9.30	......	......	......	−0.711	......
6 14 55	2	6	−2 31.02	−0.11	−2 31.13	......	......	......	−0.708	......
6 20 4	1	5	−2 16.07	−0.09	−2 16.16	......	......	......	−0.703	......
6 23 22	2	6	−2 37.66	−0.11	−2 37.77	......	......	......	−0.700	......
6 28 34	1	5	......	......	......	−0 23.83	+0.06	−0 23.77	......	+1.65
6 32 6	2	5	......	......	......	−0 58.03	+0.06	−0 57.97	......	+1.59
7 9 47	3	5	......	......	......	+1 21.18	−0.05	+1 24.13	......	+0.80
7 14 53	4	5	......	......	......	−1 55.47	−0.09	−1 55.56	......	+0.70
7 21 2	3	5	+3 42.47	+0.13	+3 42.60	......	......	......	−0.618	......
7 25 30	4	4	+3 1.62	+0.05	+3 1.67	......	......	......	−0.609	......
7 35 56	1	5	−3 14.58	−0.09	−3 14.67	......	......	......	−0.592	......
7 41 0	2	4	−3 37.95	−0.10	−3 38.05	......	......	......	−0.580	......
7 47 58	1	5	......	......	......	−0 3.91	+0.05	−0 3.86	......	+0.08
7 51 40	2	5	......	......	......	−0 38.09	+0.05	−0 38.04	......	+0.01
7 55 30	2	5	......	......	......	−0 36.94	+0.05	−0 36.89	......	−0.06
7 59 55	1	8	......	......	......	−0 1.25	+0.05	−0 1.20	......	−0.12
8 6 46	3	5	......	......	......	−1 37.73	−0.06	−1 37.79	......	−0.22
8 10 39	4	5	......	......	......	−1 42.47	−0.06	−1 42.53	......	−0.30
8 16 26	3	5	+3 2.22	+0.05	+3 2.27	......	......	......	−0.504	......
8 20 25	4	5	+2 4.93	+0.02	+2 4.95	......	......	......	−0.494	......
8 21 47	1	5	−3 52.86	−0.09	−3 52.95	......	......	......	−0.482	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Δδ
Nov. 4 8^h 30^m 16^s	2	5	−4′ 17.76	−0.06	−4′ 17.82	......	......	......	−0.470	......
10 26 35	4	5	......	......	......	−1′ 12.73	− 0.02	−1′ 12.75	......	−1.71
10 30 43	3	5	......	......	......	+2 9.17	+ 0.04	+2 9.21	......	−1.73
10 35 44	4	5	+0 19.74	0.00	+0 19.74	......	......	......	−0.100	......
10 40 12	3	5	+1 3.06	+0.02	+1 3.08	......	......	......	−0.087	......
16 21 47	1	5	......	......	......	−2 41.02	− 0.05	−2 41.07	......	+2.46
16 27 51	2	5	......	......	......	+1 12.88	+ 0.12	+1 13.00	......	+2.60
16 32 39	2	5	......	......	......	+1 13.50	+ 0.12	+1 13.62	......	+2.71
16 37 24	1	5	......	......	......	−2 38.99	− 0.06	−2 39.05	......	+2.81
16 43 21	1	4	+0 1.32	+0.05	+0 1.37	......	......	......	+0.735	......
16 49 20	2	6	+2 4.33	+0.06	+2 4.39	......	......	......	+0.737	......
15 55 14	1	5	−0 7.94	+0.04	−0 7.90	......	......	......	+0.739	......
17 0 41	2	5	+1 56.01	+0.07	+1 56.08	......	......	......	+0.739	......
17 8 46	1	5	......	......	......	−2 35.24	− 0.08	−2 35.32	......	+3.56
17 15 26	2	5	......	......	......	+1 18.84	+ 0.12	+1 18.96	......	+3.68
17 22 5	2	6	......	......	......	+1 19.68	+ 0.13	+1 19.81	......	+3.84
17 27 26	1	6	......	......	......	−2 32.93	− 0.11	−2 33.04	......	+3.95
17 42 34	1	5	−0 43.05	−0.01	−0 43.06	......	......	......	+0.730	......
17 47 45	2	6	+1 21 60	+0.07	+1 21.67	......	......	......	+0.727	......
17 53 21	2	5	......	......	......	+1 23.44	+ 0.14	+1 23.58	......	+4.49
17 57 37	2	6	......	......	......	+1 39.33	+ 0.14	+1 39.47	......	+4.65
18 2 23	2	5	+1 10.77	+0.06	+1 10.83	......	......	......	+0.717	......
18 6 51	1	7	−1 1.15	−0.05	−1 1.20	......	......	......	+0.713	......
18 11 32	1	2	−1 3.54	−0.06	−1 3.60	......	......	......	+0.709	......
Nov. 5 5 37 14	1	5	−0 29.98	+0.09	−0 29.89	......	......	......	−0.732	......
5 41 22	2	6	+0 59.50	+0.10	+0 59.60	......	......	......	−0.730	......
5 45 56	1	5	......	......	......	+2 23.48	+ 0.07	+2 23.55	......	+2.48
5 49 6	2	5	......	......	......	+2 47.63	+ 0.02	+2 47.65	......	+2.41
5 53 34	3	5	......	......	......	+2 26.24	+ 0.06	+2 26.30	......	+2.29
5 57 24	4	5	......	......	......	+1 38.32	− 0.10	+1 38.22	......	+2.23
6 2 38	4	5	−4 7.51	+0.06	−4 7.45	......	......	......	−0.715	......
6 6 32	3	5	+3 15.47	+0.17	+3 15.64	......	......	......	−0.712	......
6 28 11	5	5	+1 54.60	+0.04	+1 54.64	......	......	......	−0.690	......
6 32 47	5	5	......	......	......	−1 2.81	− 0.07	−1 2.88	......	+1.44
7 11 55	3	5	......	......	......	+2 42.68	0.00	+2 42.68	......	+0.65
7 17 0	6	5	......	......	......	+1 23.23	− 0.04	+1 23.19	......	+0.54
7 22 7	3	5	+2 16.34	+0.11	+2 16.45	......	......	......	−0.609	......
7 26 41	6	5	+3 45.71	+0.12	+3 45.83	......	......	......	−0.599	......
7 32 57	7	5	+3 45.96	+0.16	+3 46.12	......	......	......	−0.588	......
7 38 42	7	5	......	......	......	+3 28.83	0.00	+3 28.83	......	+0.14
7 45 47	7	5	......	......	......	+3 30.33	0.00	+3 30.33	......	+0.02
7 51 58	7	6	+3 31.08	+0.14	+3 31.22	......	......	......	−0.548	......
10 33 4	6	5	......	......	......	+1 59.10	+ 0.03	+1 59.13	......	−1.77
10 40 40	6	5	+1 8.58	+0.02	+1 8.60	......	......	......	−0.067	......
10 45 36	6	5	+1 4.71	+0.02	+1 4.73	......	......	......	−0.051	......
10 50 58	6	5	......	......	......	+2 1.56	+ 0.03	+2 1.59	......	−1.81
Nov. 6 10 23 8	12	5	......	......	......	+1 24.06	+ 0.02	+1 24.08	......	−1.91
10 28 2	12	5	+1 11.76	+0.02	+1 11.78	......	......	......	−0.087	......
Nov. 7 13 8 1	1	5	......	......	......	−0 15.62	+ 0.01	−0 15.61	......	−0.87
13 10 56	2	5	......	......	......	−2 16.72	− 0.02	−2 16.74	......	−0.83
13 14 3	1	5	+1 48.09	+0.04	+1 48.13	......	......	......	+0.442	......
13 16 53	2	5	+1 49.54	+0.07	+1 49.61	......	......	......	+0.449	......
Nov. 8 5 50 47	1	5	+0 46.69	+0.01	+0 46.70	......	......	......	−0.712	......
5 53 47	2	5	−0 35.46	−0.01	−0 35.47	......	......	......	−0.709	......
5 57 2	3	5	+0 48.14	+0.05	+0 48.19	......	......	......	−0.705	......
6 0 29	1	5	......	......	......	−0 47.38	− 0.02	−0 47.40	......	+1.74
6 3 39	2	5	......	......	......	+0 28.75	+ 0.03	+0 28.78	......	+1.68
6 6 28	3	5	......	......	......	+0 54.14	0.00	+0 54.14	......	+1.62
6 10 39	1	5	+0 31.40	0.00	+0 31.40	......	......	......	−0.691	......
6 13 53	2	5	−0 51.15	−0.02	−0 51.17	......	......	......	−0.686	......
6 16 43	3	5	+0 33.13	+0.03	+0 33.16	......	......	......	−0.683	......
6 21 28	1	5	......	......	......	−0 45.62	− 0.02	−0 45.64	......	+1.28
6 24 45	2	5	......	......	......	+0 30.50	+ 0.03	+0 30.53	......	+1.22
6 27 46	3	5	......	......	......	+0 55.80	0.00	+0 55.80	......	+1.16
7 1 24	3	5	......	......	......	+0 58.74	+ 0.01	+0 58.75	......	+0.49
7 5 8	1	5	......	......	......	−0 41.74	− 0.01	−0 41.75	......	+0.37

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90 Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Δδ
Nov.8 7h 9m 15s	2	5	....	......	....	+0′ 31″.23	+0″.04	+0′ 34″.27	....	+0″.34
7 13 38	1	5	−0′ 18s.45	−0s.02	−0′ 18s.47	....	......	....	−0s.591	......
7 17 10	3	5	+0 15.11	+0.02	+0 15.13	....	......	....	−0.583	......
7 21 1	2	5	−1 44.41	−0.03	−1 44.44	....	......	....	−0.575	......
7 26 51	1	5	....	......	....	−0 40.31	0.00	−0 40.31	....	+0.01
7 30 26	2	5	....	......	....	+0 35.80	+0.04	+0 35.84	....	−0.04
7 34 36	3	5	....	......	....	+1 1.13	+0.03	+1 1.16	....	−0.11
7 44 16	1	5	−0 42.57	−0.03	−0 42.60	....	......	....	−0.525	......
7 47 53	3	5	−0 39.59	0.00	−0 39.59	....	......	....	−0.515	......
7 52 21	2	5	−2 9.05	−0.04	−2 9.09	....	......	....	−0.506	......
8 9 28	1	4	−1 2.99	−0.03	−1 3.02	....	......	....	−0.464	......
8 12 4	3	4	−0 58.82	−0.01	−0 58.83	....	......	....	−0.457	......
8 15 42	1	4	....	......	....	−0 36.67	0.00	−0 36.67	....	−0.76
8 8 14	3	4	....	......	....	+1 4.18	+0.03	+1 4.21	....	−0.79
11 12 38	1	5	....	......	....	−0 29.57	−0.02	−0 29.59	....	−1.78
11 16 27	3	5	....	......	....	+1 11.55	+0.01	+1 11.56	....	−1.77
11 21 24	1	5	−3 41.32	−0.06	−3 41.38	....	......	....	+0.123	......
11 25 48	3	5	−3 37.99	−0.07	−3 38.06	....	......	....	+0.138	......
11 33 1	1	5	....	......	....	−0 29.18	−0.02	−0 29.20	....	−1.70
11 38 9	3	5	....	......	....	+1 11.99	+0.01	+1 12.00	....	−1.67
16 16 19	1	5	....	......	....	+1 13.05	+0.03	+1 13.08	....	+2.83
16 21 42	1	5	−0 3.15	−0.02	−0 3.17	....	......	....	+0.739	......
16 26 22	1	5	....	......	....	+1 12.18	+0.02	+1 12.50	....	+3.05
16 30 28	1	5	....	......	....	+1 12.19	+0.02	+1 12.21	....	+3.17
16 35 12	1	5	−0 13.48	−0.03	−0 13.51	....	......	....	+0.742	......
16 57 56	2	5	....	......	....	−1 23.66	+0.01	−1 23.65	....	+3.82
17 2 42	1	5	....	......	....	+1 10.69	−0.01	+1 10.68	....	+3.91
17 10 17	2	5	+0 58.44	+0.07	+0 58.51	....	......	....	+0.737	......
17 30 59	1	7	−0 54.89	−0.06	−0 54.95	....	......	....	+0.726	......
17 52 6	1	3	−1 10.65	−0.08	−1 10.73	....	......	....	+0.687	......
Nov.10 5 44 11	1	5	−4 19.79	−0.15	−4 19.94	....	......	....	−0.706	......
5 51 31	1	3	....	......	....	−0 0.06	+0.13	+0 0.07	....	+1.67
5 56 36	1	5	−4 29.20	−0.15	−4 29.35	....	......	....	−0.693	......
6 3 48	1	4	....	......	....	−0 0.24	+0.12	−0 0.12	....	+1.39
7 16 28	1	3	....	......	....	−0 0.26	+0.08	−0 0.18	....	−0.01
14 51 36	1	5	....	......	....	−0 32.77	−0.01	−0 32.78	....	+1.22
14 56 13	2	5	....	......	....	−0 32.96	−0.01	−0 32.97	....	+1.32
15 2 56	1	5	−0 16.40	0.00	−0 16.40	....	......	....	+0.688	......
15 15 50	1	3	−0 27.38	0.00	−0 27.38	....	......	....	+0.703	......
15 37 52	2	5	−0 13.71	0.00	−0 13.71	....	......	....	+0.723	......
16 41 45	2	5	−1 1.83	−0.04	−1 1.87	....	......	....	+0.742	......
16 45 41	1	5	−1 35.20	−0.07	−1 35.27	....	......	....	+0.740	......
16 49 30	3	5	−0 40.76	−0.05	−0 40.81	....	......	....	+0.739	......
16 54 1	2	5	....	......	....	−0 48.81	−0.08	−0 48.89	....	+4.00
16 57 57	1	6	....	......	....	−0 49.63	−0.11	−0 49.74	....	+4.09
17 3 9	3	6	....	......	....	+1 8.12	0.00	+1 8.12	....	+4.21
Nov.11 6 28 13	9.6	5	−1 37.64	−0.04	−1 37.68	....	......	....	−0.640	......
6 33 3	9.6	5	....	......	....	+0 35.15	+0.05	+0 35.20	....	+0.68
6 37 10	9.6	5	−1 41.79	−0.04	−1 41.83	....	......	....	−0.621	......
6 41 33	9.6	5	−1 47.96	−0.04	−1 48.00	....	......	....	−0.617	......
6 45 59	9.6	5	....	......	....	+0 34.22	+0.04	+0 34.26	....	+0.43
6 49 17	9.6	5	....	......	....	+0 34.19	+0.04	+0 34.23	....	+0.37
7 9 2	9.8	5	....	......	....	+0 33.30	+0.04	+0 33.34	....	+0.01
7 14 5	9.8	5	−2 13.56	−0.05	−2 13.61	....	......	....	−0.551	......
7 18 59	9.8	5	−2 17.26	−0.05	−2 17.31	....	......	....	−0.540	......
7 23 34	9.8	5	....	......	....	+0 32.42	+0.04	+0 32.46	....	−0.22
7 46 23	9.8	5	....	......	....	+0 31.94	+0.04	+0 31.98	....	−0.43
7 51 57	9.8	5	−2 43.66	−0.05	−2 43.71	....	......	....	−0.489	......
7 59 37	9.8	6	−2 49.50	−0.05	−2 49.55	....	......	....	−0.469	......
8 5 13	9.8	5	....	......	....	+0 30.04	+0.04	+0 30.08	....	−0.86
Nov.13 5 48 40	1	6	−2 40.96	−0.11	−2 41.07	....	......	....	−0.678	......
5 53 26	2	6	−3 15.45	−0.07	−3 15.52	....	......	....	−0.671	......
6 0 33	1	5	....	......	....	−1 21.43	+0.04	−1 21.39	....	+1.12
6 3 57	2	5	....	......	....	+1 39.71	+0.01	+1 39.72	....	+1.06
6 10 11	1	5	−2 57.69	−0.11	−2 57.80	....	......	....	−0.647	......
6 14 4	2	5	−3 30.83	−0.07	−3 30.90	....	......	....	−0.643	......
6 19 3	1	5	....	......	....	−1 23.51	+0.04	−1 23.47	....	+0.76
6 22 20	2	5	....	......	....	+1 37.41	+0.10	+1 37.51	....	+0.68

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90° Time	Comp. Star.	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Nov.13	6h 52m 45s	1	5	...	...	...	−1′ 28″.49	+0″.03	−1′ 28″.46	...	+0″.12
	6 56 26	2	5	...	...	...	+1 32.87	+0.09	+1 32.96	...	+0.05
	7 4 5	1	3	−3′ 37″.96	−0″.11	−3 38″.07	...	...	...	−0s.549	...
	7 50 51	1	5	−4 13.66	−0.11	−4 13.77	...	...	...	−0.434	...
	7 54 45	2	5	−4 48.51	−0.08	−4 48.59	...	...	...	−0.424	...
	7 59 59	1	5	...	...	...	−1 37.93	+0.02	−1 37.91	...	−0.91
	8 3 21	2	5	...	...	...	+1 23.24	+0.07	+1 23.31	...	−0.97
	8 49 19	1	5	...	...	...	−2 35.77	−0.06	−2 35.83	...	−1.44
	8 55 8	2	5	...	...	...	−0 9.75	0.00	−0 9.75	...	−1.49
	9 1 21	1	5	+2 1.82	+0.02	+2 1.84	...	...	...	−0.231	...
	9 6 12	2	5	+4 10.53	+0.10	+4 10.63	...	...	...	−0.216	...
	9 12 58	1	5	...	...	...	−2 40.56	−0.05	−2 40.61	...	−1.61
	9 17 50	2	5	...	...	...	−0 13.71	−0.01	−0 13.72	...	−1.64
	9 23 16	1	5	+1 44.29	+0.02	+1 44.31	...	...	...	−0.160	...
	9 28 39	2	5	+3 52.80	+0.07	+3 52.87	...	...	...	−0.144	...
	11 24 26	1	5	+0 50.23	+0.01	+0 50.24	...	...	...	+0.225	...
	11 29 51	2	5	+2 16.80	+0.05	+2 16.85	...	...	...	+0.241	...
	11 35 56	1	5	...	...	...	+0 15.44	+0.01	+0 15.45	...	−1.46
	11 40 25	2	5	...	...	...	−0 41.53	0.00	−0 41.53	...	−1.42
	11 45 22	1	5	+0 33.44	+0.01	+0 33.45	...	...	...	+0.290	...
	11 50 13	2	5	+2 0.43	+0.01	+2 0.47	...	...	...	+0.305	...
	11 55 31	1	5	...	...	...	+0 11.02	0.00	+0 11.02	...	−1.29
	11 59 27	2	5	...	...	...	−0 45.92	0.00	−0 45.92	...	−1.25
	15 56 23	3	5	...	...	...	−1 44.56	+0.03	−1 44.53	...	+3.09
	16 2 4	2	5	...	...	...	+1 16.87	−0.02	+1 16.85	...	+3.21
	16 8 31	2	5	−1 14.12	−0.08	−1 14.20	...	...	...	+0.740	...
	16 14 9	3	5	+1 19.05	+0.07	+1 19.12	...	...	...	+0.740	...
	16 20 35	3	5	...	...	...	−1 51.04	+0.01	−1 51.03	...	+3.65
	16 26 36	2	5	...	...	...	+1 10.29	−0.04	+1 10.25	...	+3.78
	16 32 7	2	5	−1 30.65	−0.09	−1 30.74	...	...	...	+0.737	...
	16 35 50	3	5	+1 3.68	+0.08	+1 3.76	...	...	...	+0.736	...
	16 54 26	3	5	...	...	...	−1 59.79	−0.02	−1 59.81	...	+4.35
	16 58 50	2	5	...	...	...	+1 1.70	−0.08	+1 1.62	...	+4.52
	17 5 49	2	5	−1 51.34	−0.12	−1 54.46	...	...	...	+0.720	...
	17 9 57	3	5	+0 39.74	+0.05	+0 39.79	...	...	...	+0.717	...
	17 15 58	3	5	...	...	...	−2 5.67	−0.05	−2 5.72	...	+4.90
	17 20 1	2	5	...	...	...	+0 55.88	−0.13	+0 55.75	...	+4.98
	17 32 8	2	5	...	...	...	+0 52.99	−0.14	+0 52.85	...	+5.27
	17 36 36	3	5	+0 21.59	+0.01	+0 21.60	...	...	...	+0.690	...
	17 40 36	3	6	+0 18.57	+0.01	+0 18.58	...	...	...	+0.686	...
	17 46 16	2	6	...	...	...	+0 49.20	−0.17	+0 49.03	...	+5.56
	17 53 2	2	6	...	...	...	+0 47.26	−0.18	+0 47.08	...	+5.69
	17 58 15	3	6	+0 6.58	−0.03	+0 6.55	...	...	...	+0.662	...
	18 4 11	3	6	+0 2.74	−0.04	+0 2.70	...	...	...	+0.654	...
	18 8 12	2	5	...	...	...	+0 43.36	−0.22	+0 43.14	...	+6.01
	18 13 5	2	5	...	...	...	+0 41.96	−0.23	+0 41.73	...	+6.10
	18 16 36	3	5	−0 5.73	−0.07	−0 5.80	...	...	...	+0.631	...
Nov.15	6 13 25	1	5	+0 36.60	0.00	+0 36.60	...	...	...	+0.619	...
	6 17 6	2	5	+1 19.30	+0.06	+1 19.36	...	...	...	−0.612	...
	6 21 36	1	5	...	...	...	−1 11.74	−0.03	−1 11.77	...	+0.49
	6 25 19	2	5	...	...	...	+1 6.97	0.00	+1 6.97	...	+0.41
	6 49 14	1	5	...	...	...	−1 18.10	−0.02	−1 18.12	...	−0.02
	6 53 1	2	5	...	...	...	+1 0.95	0.00	+1 0.95	...	−0.07
	6 56 56	1	5	+0 4.03	−0.02	+0 4.01	...	...	...	−0.534	...
	7 0 18	2	5	+0 47.27	+0.03	+0 47.30	...	...	...	−0.525	...
	7 4 42	1	5	...	...	...	−1 21.56	−0.02	−1 21.58	...	−0.26
	7 8 16	2	5	...	...	...	+0 57.65	+0.01	+0 57.66	...	−0.33
	7 40 54	1	5	...	...	...	−1 29.86	−0.02	−1 29.88	...	−0.79
	7 44 27	2	5	...	...	...	+0 48.63	+0.01	+0 48.64	...	−0.85
	7 48 32	2	5	+0 11.10	+0.01	+0 11.11	...	...	...	−0.412	...
	7 51 53	1	5	−0 36.87	−0.03	−0 36.90	...	...	...	−0.398	...
	7 55 45	2	5	...	...	...	+0 46.07	+0.01	+0 46.08	...	−0.99
Nov.21	5 33 26	1	4	...	...	...	−0 10.62	−0.02	−0 10.64	...	+0.89
	5 36 52	2	5	...	...	...	+0 1.04	+0.03	+0 1.07	...	+0.82
	5 40 34	3	5	...	...	...	+0 56.71	+0.04	+0 56.75	...	+0.74
	5 47 5	1	5	+0 57.24	+0.02	+0 57.26	...	...	...	−0.592	...
	5 51 5	2	5	−1 39.41	−0.05	−1 39.46	...	...	...	−0.585	...
	5 54 44	3	5	−1 25.62	−0.02	−1 25.64	...	...	...	−0.578	...
	6 0 16	1	5	...	...	...	−0 22.70	−0.02	−0 22.72	...	+0.39

MICROMETRICAL OBSERVATIONS OF *EROS* — *Continued*

Date 1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Nov. 21	6ʰ 4ᵐ 25ˢ	2	6	....	......	....	−0′ 11″.86	+0″.03	−0′ 11″.83	....	+0″.32
	6 8 4	3	5	....	......	....	+0 41.09	+0.04	+0 41.13	....	+0.25
	6 12 56	4	5	....	......	....	+0 39.93	+0.08	+0 40.01	....	+0.16
	6 17 56	4	4	−4′ 30″.89	−0″.10	−4 30″.99	....	......	....	−0ˢ.532	......
	6 24 0	4	4	−4 31.41	−0.10	−4 31.51	....	......	....	−0.519	......
	6 29 44	4	1	....	......	....	+0 32.25	+0.07	+0 32.32	....	−0.12
	7 11 56	1	5	....	......	....	−0 56.01	−0.02	−0 56.06	....	−0.72
	7 17 8	2	5	....	......	....	−0 45.73	+0.01	−0 45.72	....	−0.78
	7 21 30	3	5	....	......	....	+0 9.88	+0.03	+0 9.91	....	−0.83
	7 27 7	1	5	−0 3.97	−0.01	−0 3.98	....	......	....	−0.365	......
	7 31 54	2	5	−2 40.92	−0.07	−2 40.99	....	......	....	−0.354	......
	7 36 29	3	5	−2 27.47	−0.05	−2 27.52	....	......	....	−0.340	......
	7 42 50	1	5	....	......	....	−1 10.96	−0.02	−1 10.98	....	−1.07
	7 47 56	2	5	....	......	....	−1 0.35	0.00	−1 0.35	....	−1.12
	7 52 25	3	5	....	......	....	−0 5.22	+0.02	−0 5.20	....	−1.16
	8 14 13	1	5	....	......	....	−1 26.16	−0.01	−1 26.17	....	−1.34
	8 20 8	2	5	....	......	....	−1 15.90	0.00	−1 15.90	....	−1.39
	8 25 27	3	5	....	......	....	−0 21.13	+0.02	−0 21.11	....	−1.42
	16 46 13	1	5	....	......	....	−1 21.79	+0.12	−1 21.67	....	+5.32
	16 54 40	1	5	+2 8.48	+0.14	+2 8.62	....	......	....	+0.666	......
	17 6 45	1	7	....	......	....	−1 33.81	+0.09	−1 33.72	....	+5.72
	17 15 42	1	6	+1 56.03	+0.12	+1 56.15	....	......	....	+0.639	......
	17 26 21	1	5	....	......	....	−1 45.32	+0.07	−1 45.25	....	+6.14
	17 33 30	1	5	+1 47.91	+0.10	+1 48.01	....	......	....	+0.616	......
Nov. 22	7 25 16	1	6	....	......	....	−1 24.15	−0.01	−1 24.16	....	−0.92
	7 30 39	2	5	....	......	....	−2 28.56	−0.04	−2 28.60	....	−0.99
	7 37 13	1	5	−1 27.74	−0.04	−1 27.78	....	......	....	−0.320	......
	7 42 39	2	5	−0 30.39	−0.03	−0 30.42	....	......	....	−0.303	......
	7 49 39	1	6	....	......	....	−1 36.88	−0.02	−1 36.90	....	−1.17
	7 55 21	2	5	....	......	....	−2 41.21	−0.04	−2 41.25	....	−1.22
	8 22 39	1	5	....	......	....	−1 54.38	−0.03	−1 54.41	....	−1.41
	8 27 40	2	5	....	......	....	−2 58.30	−0.05	−2 58.35	....	−1.44
	8 34 11	1	5	−2 1.77	−0.04	−2 1.81	....	......	....	−0.152	......
	8 38 52	2	5	−1 3.61	−0.03	−1 3.64	....	......	....	−0.140	......
	8 46 5	1	6	....	......	....	−2 6.98	−0.03	−2 7.01	....	−1.52
	8 51 50	2	6	....	......	....	−3 11.29	−0.05	−3 11.34	....	−1.55
	15 52 45	1	5	....	......	....	+4 22.36	+0.24	+4 22.60	....	+4.25
	15 54 30	2	5	....	......	....	+3 39.93	+0.10	+3 40.03	....	+4.27
	16 5 12	1	5	+1 27.16	+0.07	+1 27.23	....	......	....	+0.704	......
	16 9 56	2	5	−0 36.12	−0.05	−0 36.17	....	......	....	+0.701	......
	16 16 58	1	5	....	......	....	+4 7.54	+0.27	+4 7.81	....	+4.79
	16 23 21	2	5	....	......	....	+3 24.62	+0.11	+3 24.73	....	+4.92
	16 29 9	2	5	−0 45.75	−0.04	−0 45.79	....	......	....	+0.687	......
	16 32 56	1	5	+1 13.62	+0.10	+1 13.72	....	......	....	+0.683	......
	16 37 55	1	5	+1 11.32	+0.11	+1 11.43	....	......	....	+0.678	......
	16 44 40	1	5	....	......	....	+3 50.33	+0.32	+3 50.65	....	+5.39
	16 49 19	2	5	....	......	....	+3 8.58	+0.12	+3 8.70	....	+5.48
	16 59 6	1	5	+1 1.25	+0.14	+1 1.39	....	......	....	+0.654	......
	17 6 1	2	5	−1 3.39	−0.02	−1 3.41	....	......	....	+0.646	......
	17 14 22	1	5	....	......	....	+3 31.66	+0.40	+3 32.06	....	+5.99
	17 19 35	2	5	....	......	....	+2 49.90	+0.11	+2 50.01	....	+6.11
	17 26 17	1	6	+0 47.97	+0.18	+0 48.15	....	......	....	+0.618	......
Nov. 23	9 15 17	..	5	....	......	....	−2 6.86	−0.04	−2 6.90	....	−1.51
	9 52 12	..	5	+0 9.29	+0.01	+0 9.30	....	......	....	+0.108	......
	9 57 3	..	5	+0 6.63	+0.01	+0 6.61	....	......	....	+0.124	......
	10 2 31	..	5	....	......	....	−2 17.25	−0.04	−2 17.29	....	−1.46
Nov. 25	6 33 28	1	5	....	......	....	−0 18.01	+0.01	−0 18.00	....	−0.35
	6 37 21	2	5	....	......	....	+0 49.62	−0.03	+0 49.59	....	−0.41
	6 42 59	1	5	−4 18.69	−0.10	−4 18.79	....	......	....	−0.413	......
	6 47 10	2	5	+4 21.93	+0.10	+4 22.03	....	......	....	−0.403	......
	6 53 31	1	1	−4 24.18	−0.09	−4 24.27	....	......	....	−0.388	......
	6 57 1	2	1	+4 17.39	+0.09	+4 17.48	....	......	....	−0.378	......
	7 1 36	1	5	....	......	....	−0 35.04	+0.03	−0 35.01	....	−0.71
	7 5 9	2	5	....	......	....	+0 32.44	−0.03	+0 32.41	....	−0.76
	7 45 57	1	5	....	......	....	−4 2.10	+0.01	−4 2.09	....	−1.15
	7 50 15	2	5	....	......	....	+0 4.55	−0.02	+0 4.53	....	−1.18
	7 56 55	1	5	−4 15.26	−0.09	−4 15.35	....	......	....	−0.211	......
	8 1 21	2	5	+3 46.15	+0.07	+3 46.22	....	......	....	−0.199	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Nov.25 8h 7m 5s	1	5	....	......	....	−1′ 16″.08	0″.00	−1′ 16″.08	....	−1″.29
8 11 47	2	5	....	......	....	−0 9.07	−0.02	−0 9.09	....	−1.32
8 42 22	1	5	....	......	....	−1 38.46	−0.02	−1 38.48	....	−1.44
8 47 1	2	5	....	......	....	−0 31.72	−0.01	−0 31.73	....	−1.45
8 54 18	1	5	−5′ 22″.89	−0″.09	−5′ 22″.98	....	......	....	−0s.040	......
8 59 39	2	5	+3 18.80	+0.06	+3 18.86	....	......	....	−0.022	......
9 6 42	1	6	....	......	....	−1 53.95	−0.03	−1 53.98	....	−1.47
9 12 35	2	6	....	......	....	−0 48.34	−0.01	−0 48.35	....	−1.46
15 18 53	2	5	....	......	....	−5 4.57	−0.16	−5 4.73	....	+3.96
15 25 27	3	5	....	......	....	+4 25.55	+0.26	+4 25.81	....	+4.09
15 32 57	2	5	−0 21.58	−0.02	−0 21.60	....	......	....	+0.698	......
15 39 22	3	5	+2 19.25	+0.10	+2 19.35	....	......	....	+0.695	......
15 49 14	2	5	....	......	....	−5 26.68	−0.27	−5 26.95	....	+4.62
15 54 47	3	5	....	......	....	+4 4.20	+0.34	+4 4.54	....	+4.75
16 10 52	2	5	....	......	....	−5 42.33	−0.31	−5 42.64	....	+5.07
16 16 57	3	5	....	......	....	+3 47.94	+0.39	+3 48.33	....	+5.22
16 26 6	3	5	+2 2.55	+0.19	+2 2.74	....	......	....	+0.660	......
16 31 23	4	5	+1 34.02	+0.18	+1 34.20	....	......	....	+0.654	......
16 38 32	3	5	....	......	....	+3 31.86	+0.45	+3 32.31	....	+5.64
16 43 30	4	5	....	......	....	+4 24.34	+0.50	+4 24.84	....	+5.77
16 50 17	3	5	+1 53.96	+0.24	+1 54.20	....	......	....	+0.629	......
16 55 15	4	5	+1 25.36	+0.24	+1 25.60	....	......	....	+0.624	......
17 3 30	3	5	....	......	....	+3 14.11	+0.55	+3 14.66	....	+6.16
17 8 50	4	5	....	......	....	+4 6.21	+0.62	+4 6.83	....	+6.28
17 22 2	3	5	+1 42.37	+0.30	+1 42.67	....	......	....	+0.581	......
17 26 36	4	5	+1 14.21	+0.32	+1 14.53	....	......	....	+0.574	......
17 33 35	3	5	....	......	....	+2 52.50	+0.71	+2 53.21	....	+6.72
17 39 37	4	6	....	......	....	+3 43.99	+0.76	+3 44.75	....	+6.83
17 51 46	3	5	....	......	....	+2 39.20	+0.83	+2 40.03	....	+7.03
17 58 32	3	5	+1 29.78	+0.38	+1 30.16	....	......	....	+0.512	......
Nov.26 5 35 54	4	5	....	......	....	−3 58.36	−0.04	−3 58.40	....	+0.50
5 42 22	1	5	....	......	....	+5 3.05	+0.11	+5 3.16	....	+0.40
5 48 21	4	5	−2 58.77	−0.15	−2 58.92	....	......	....	−0.526	......
5 52 28	3	5	−2 34.21	−0.13	−2 34.34	....	......	....	−0.518	......
5 56 49	1	5	−2 27.31	+0.01	−2 27.30	....	......	....	−0.510	......
6 2 52	3	5	....	......	....	−5 11.28	−0.05	−5 11.33	....	+0.05
6 7 5	4	5	....	......	....	−4 18.02	−0.04	−4 18.06	....	−0.01
6 11 9	1	5	....	......	....	+4 44.70	+0.11	+4 44.81	....	−0.08
6 19 51	3	5	−2 46.02	−0.13	−2 46.15	....	......	....	−0.457	......
6 24 30	4	5	−3 14.37	−0.13	−3 14.50	....	......	....	−0.448	......
6 28 50	1	5	−2 40.60	0.00	−2 40.60	....	......	....	−0.438	......
7 13 46	1	5	....	......	....	+4 4.56	+0.09	+4 4.65	....	−0.88
7 19 3	4	5	....	......	....	−4 35.76	−0.05	−4 35.81	....	−0.93
7 25 19	4	5	−3 41.38	−0.11	−3 41.49	....	......	....	−0.290	......
7 30 16	1	5	−3 7.49	−0.03	−3 7.52	....	......	....	−0.276	......
7 37 25	4	5	....	......	....	−4 23.76	−0.06	−4 23.82	....	−1.10
7 42 47	1	5	....	......	....	+3 45.67	+0.08	+3 45.75	....	−1.13
8 9 17	1	5	....	......	....	+3 27.98	+0.07	+3 28.05	....	−1.30
8 15 45	1	5	−3 27.90	−0.05	−3 27.95	....	......	....	−0.142	......
12 14 41	2	6	....	......	....	+2 48.59	0.00	+2 48.59	....	+0.25
12 22 16	2	6	−2 59.29	+0.12	−2 59.41	....	......	....	+0.536	......
12 31 8	2	5	....	......	....	+2 36.53	0.00	+2 36.53	....	+0.53
12 37 20	1	5	....	......	....	+0 18.54	−0.09	+0 18.45	....	+0.64
12 44 0	1	5	−5 25.74	−0.15	−5 25.89	....	......	....	+0.577	......
12 51 57	1	5	....	......	....	+0 7.92	−0.10	+0 7.82	....	+0.92
12 59 14	2	5	....	......	....	+2 15.39	+0.02	+2 15.41	....	+1.05
15 15 2	2	5	−4 5.72	−0.22	−4 5.94	....	......	....	+0.699	......
15 21 43	5	5	+4 36.42	+0.22	+4 36.64	....	......	....	+0.697	......
15 27 23	6	5	+0 1.09	+0.01	+0 1.10	....	......	....	+0.695	......
15 33 39	2	5	....	......	....	+0 19.35	−0.26	+0 19.09	....	+4.36
15 39 29	5	5	....	......	....	−0 56.36	+0.21	−0 56.15	....	+4.50
15 44 26	6	5	....	......	....	+1 4.03	+0.04	+1 4.07	....	+4.61
16 0 38	2	6	....	......	....	−0 1.24	−0.29	−0 1.53	....	+4.96
16 10 16	5	5	+3 39.90	+0.25	+3 40.15	....	......	....	+0.669	......
16 15 26	6	5	−0 15.06	+0.01	−0 15.05	....	......	....	+0.664	......
16 20 51	2	5	−4 28.56	−0.33	−4 28.89	....	......	....	+0.660	......
16 29 49	5	5	....	......	....	−1 31.85	+0.25	−1 31.60	....	+5.57
16 33 57	6	5	....	......	....	+0 25.91	0.00	+0 25.91	....	+5.67
16 38 10	2	5	....	......	....	−0 29.88	−0.44	−0 30.32	....	+5.76
16 49 26	2	5	−4 37.09	−0.38	−4 37.47	....	......	....	+0.625	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90 Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Nov.26 16ʰ 58ᵐ 13ˢ	2	5	....	......	....	−0′ 44″.30	−0″.60	−0′ 44″.90	....	+6″.20
Nov.27 5 21 40	7.7	5	....	......	....	−2 52.55	−0.11	−2 52.66	....	+0.72
5 25 4	1	5	....	......	....	−0 18.12	−0.01	−0 18.13	....	+0.65
5 30 14	7.7	5	+3′ 37″.30	+0″.05	+3′ 37″.35	....	......	....	−0ˢ.548	......
5 31 31	1	5	+0 20.79	0.00	+0 20.79	....	......	....	−0.540	......
5 39 29	7.7	5	....	......	....	−3 3.92	−0.11	−3 4.03	....	+0.40
5 43 9	1	5	....	......	....	−0 30.04	−0.01	−0 30.05	....	+0.34
5 51 32	7.7	5	+3 28.04	+0.03	+3 28.07	....	......	....	−0.494	......
5 59 15	1	5	+0 11.06	−0.01	+0 11.05	....	......	....	−0.489	......
6 4 11	2	5	−2 8.83	−0.03	−2 8.86	....	......	....	−0.479	......
6 8 22	2	5	....	......	....	+1 44.96	+0.06	+1 45.02	....	−0.06
6 12 45	2	5	−2 12.08	−0.03	−2 12.11	....	......	....	−0.461	......
6 40 28	7.7	5	....	......	....	−3 44.71	−0.09	−3 44.80	....	−0.50
6 44 53	1	5	....	......	....	−1 11.17	−0.02	−1 11.19	....	−0.55
6 48 46	2	5	....	......	....	+1 17.75	+0.04	+1 17.79	....	−0.60
6 53 31	7.7	5	+3 3.92	+0.02	+3 3.91	....	......	....	−0.361	......
6 57 42	1	5	−0 12.00	−0.02	−0 12.02	....	......	....	−0.350	......
7 1 41	2	5	−2 31.58	−0.04	−2 31.62	....	......	....	−0.340	......
7 6 12	7.7	5	....	......	....	−4 1.92	−0.09	−4 2.01	....	−0.80
7 9 51	1	5	....	......	....	−1 28.19	−0.02	−1 28.21	....	−0.83
7 14 23	2	5	....	......	....	+1 0.42	+0.03	+1 0.45	....	−0.88
7 44 51	7.7	5	....	......	....	−4 28.52	−0.09	−4 28.61	....	−1.13
7 49 56	1	5	....	......	....	−1 55.71	−0.03	−1 55.74	....	−1.17
7 53 54	2	4	....	......	....	+0 33.29	+0.02	+0 33.31	....	−1.20
7 59 45	7.7	5	+2 37.21	+0.03	+2 37.24	....	......	....	−0.177	......
8 4 10	1	4	−0 39.21	−0.02	−0 39.23	....	......	....	−0.162	......
8 7 48	2	4	−2 85.59	−0.05	−2 58.64	....	......	....	−0.153	......
8 13 21	7.7	5	....	......	....	−4 48.33	−0.09	−4 48.42	....	−1.29
Nov.29 5 31 41	1	5	....	......	....	−0 39.40	+0.01	−0 39.39	....	+0.43
5 35 1	2	5	....	......	....	+1 21.53	+0.06	+1 21.59	....	+0.37
5 38 29	3	5	....	......	....	−0 55.50	−0.05	−0 55.55	....	+0.32
5 43 22	1	5	−1 16.01	−0.04	−1 16.05	....	......	....	−0.496	......
5 48 23	2	5	−2 17.44	−0.04	−2 17.48	....	......	....	−0.486	......
5 52 0	3	5	+2 29.69	+0.05	+2 29.74	....	......	....	−0.478	......
5 57 15	1	5	....	......	....	−0 57.81	0.00	−0 57.81	....	+0.02
6 1 31	2	5	....	......	....	+1 2.33	+0.05	+1 2.38	....	−0.04
6 5 55	3	5	....	......	....	−1 15.33	−0.05	−1 15.38	....	−0.10
6 11 31	1	5	−1 25.18	−0.04	−1 25.22	....	......	....	−0.435	......
6 15 35	2	5	−2 26.43	−0.04	−2 26.47	....	......	....	−0.426	......
6 19 0	3	5	+2 21.49	+0.03	+2 21.52	....	......	....	−0.416	......
6 23 24	1	5	....	......	....	−1 16.65	−0.01	−1 16.66	....	−0.35
6 27 7	2	5	....	......	....	+0 43.80	+0.04	+0 43.84	....	−0.40
6 30 25	3	5	....	......	....	−1 33.14	−0.05	−1 33.19	....	−0.43
7 14 11	1	5	....	......	....	−1 53.82	−0.02	−1 53.84	....	−0.90
7 20 59	2	5	....	......	....	−0 4.17	+0.01	−0 4.16	....	−0.95
7 26 31	3	5	....	......	....	−2 13.99	−0.05	−2 14.04	....	−0.99
7 32 19	1	5	−1 50.91	−0.05	−1 50.96	....	......	....	−0.224	......
7 39 36	2	5	−2 53.15	−0.05	−2 53.20	....	......	....	−0.199	......
7 45 20	3	5	+1 53.29	+0.02	+1 53.31	....	......	....	−0.182	......
7 52 34	1	5	....	......	....	−2 22.45	−0.04	−2 22.49	....	−1.17
7 58 21	2	5	....	......	....	−0 23.47	0.00	−0 23.47	....	−1.20
8 5 16	3	5	....	......	....	−2 43.00	−0.05	−2 43.05	....	−1.23
8 23 58	1	2	....	......	....	−2 46.09	−0.05	−2 46.14	....	−1.29
8 31 16	1	2	....	......	....	−2 51.73	−0.05	−2 51.78	....	−1.30
15 42 11	11	5	....	......	....	−0 37.96	−0.01	−0 37.97	....	+4.95
15 47 19	11	5	+0 14.75	+0.01	+0 14.76	....	......	....	+0.663	......
15 55 25	11	7	....	......	....	−0 48.51	−0.03	−0 48.54	....	+5.20
16 4 36	11	8	+0 11.70	0.00	+0 11.70	....	......	....	+0.650	......
16 11 37	11	8	....	......	....	−1 4.50	−0.06	−1 4.56	....	+5.62
16 30 23	11	7	....	......	....	−1 18.14	−0.11	−1 18.25	....	+5.94
16 38 15	11	6	+0 5.03	−0.04	+0 4.99	....	......	....	+0.607	......
16 41 58	11	5	....	......	....	−1 29.69	−0.14	−1 29.83	....	+6.20
Dec. 1 15 30 3	1	5	......	......	....	−1 38.85	+0.01	−1 38.84	....	+4.91
15 35 5	2	5	....	......	....	+0 17.10	−0.11	+0 16.99	....	+5.02
15 41 42	1	5	+0 56.85	+0.05	+0 56.90	....	......	....	+0.619	......
15 48 5	2	6	−1 43.81	−0.14	−1 43.95	....	......	....	+0.641	......
16 1 36	2	9	......	......	....	−0 8.90	−0.21	−0 9.11	....	+5.64
16 19 14	1	2	....	......	....	−2 22.77	−0.12	−2 22.89	....	+5.94

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Dec. 1	16^h 26^m 24^s	2	5	−1′ 48ˢ.85	−0ˢ.19	−1′ 49ˢ.04	....	......	....	+0ˢ.600	......
Dec. 2	5 42 29	1	5	....	......	....	+0′ 13″.76	0″.00	+0′ 13″.76	....	+0″.17
	5 47 4	2	5	....	......	....	+1 48.70	+0.03	+1 48.73	....	+0.12
	5 51 21	3	5	....	......	....	−2 6.34	−0.04	−2 6.38	....	+0.05
	5 56 24	2	5	+0 22.91	+0.03	+0 22.94	....	......	....	−0.432	......
	6 2 27	3	5	−0 28.13	−0.03	−0 28.16	....	......	....	−0.418	......
	6 11 43	2	5	....	......	....	+1 28.80	+0.02	+1 28.82	....	−0.23
	6 16 11	3	5	....	......	....	−2 26.03	−0.03	−2 26.06	....	−0.29
Dec. 5	6 49 20	1	5	....	......	....	+1 44.58	+0.03	+1 44.61	....	−0.60
	6 53 23	2	5	....	......	....	−0 19.00	+0.01	−0 18.99	....	−0.65
	6 57 51	1	5	+0 13.57	+0.01	+0 13.58	....	......	....	−0.239	......
	7 2 8	2	5	−2 20.86	−0.05	−2 20.91	....	......	....	−0.228	......
	7 6 31	1	5	....	......	....	+1 29.81	+0.02	+1 29.83	....	−0.75
	7 10 25	2	5	....	......	....	−0 33.86	0.00	−0 33.86	....	−0.78
	7 28 43	1	5	....	......	....	+1 10.07	+0.02	+1 10.09	....	−0.88
	7 32 22	3	5	....	......	....	−1 14.21	−0.02	−1 14.23	....	−0.90
	7 36 50	2	5	....	......	....	−0 57.23	−0.01	−0 57.24	....	−0.92
	7 42 3	1	5	+0 10.60	+0.01	+0 10.61	....	......	....	−0.118	......
	7 45 43	3	5	+0 13.36	0.00	+0 13.36	....	......	....	−0.106	......
	7 49 55	2	5	−2 24.00	−0.04	−2 24.04	....	......	....	−0.095	......
	7 55 11	1	5	....	......	....	+0 46.70	+0.01	+0 46.71	....	−0.97
	7 59 2	3	5	....	......	....	−1 37.81	−0.03	−1 37.84	....	−0.98
	8 3 35	2	5	....	......	....	−1 21.14	−0.02	−1 21.16	....	−0.99
	8 13 49	1	5	....	......	....	+0 29.95	+0.01	+0 29.96	....	−1.01
	8 18 28	3	5	....	......	....	−1 55.06	−0.03	−1 55.09	....	−1.01
	8 24 33	1	5	+0 7.83	0.00	+0 7.83	....	......	....	+0.006	......
	8 29 41	3	5	+0 10.47	0.00	+0 10.47	....	......	....	+0.020	......
	8 34 54	1	5	....	......	....	+0 11.11	0.00	+0 11.11	....	−1.01
	8 38 51	3	5	....	......	....	−2 13.39	−0.04	−2 13.43	....	−1.00
	9 2 12	1	5	....	......	....	−0 13.61	0.00	−0 13.61	....	−0.94
	9 7 23	3	5	....	......	....	−2 39.58	−0.05	−2 39.63	....	−0.92
	9 13 2	1	5	+0 4.70	0.00	+0 4.70	....	......	....	+0.146	......
	9 17 7	3	5	+0 7.55	+0.01	+0 7.56	....	......	....	+0.157	......
	9 21 59	1	5	....	......	....	−0 31.70	−0.01	−0 31.71	....	−0.85
	9 25 39	1	5	+0 3.87	0.00	+0 3.87	....	......	....	+0.182	......
	9 29 37	1	5	....	......	....	−0 38.70	−0.01	−0 38.71	....	−0.80
	13 53 12	1	5	....	......	....	−1 10.37	−0.07	−1 10.44	....	+3.27
	13 58 44	1	5	−1 0.78	−0.04	−1 0.82	....	......	....	+0.656	......
	14 3 9	1	5	....	......	....	−1 19.81	−0.08	−1 19.89	....	+3.50
	14 11 25	1	5	....	......	....	−1 28.03	−0.09	−1 28.12	....	+3.67
	14 18 32	1	5	−1 0.33	−0.04	−1 0.37	....	......	....	+0.660	......
	14 24 42	1	5	....	......	....	−1 40.93	−0.11	−1 41.04	....	+3.95
	14 32 0	11	5	....	......	....	−0 15.52	+0.07	−0 15.45	....	+4.10
	14 36 49	1	5	....	......	....	−1 52.73	−0.13	−1 52.86	....	+4.20
	14 41 53	11	5	+1 29.57	+0.10	+1 29.67	....	......	....	+0.657	......
	14 58 32	1	5	−0 58.24	−0.07	−0 58.31	....	......	....	+0.651	......
	15 7 53	1	5	....	......	....	−2 23.07	−0.18	−2 23.25	....	+4.89
Dec. 8	6 23 13	9.8	5	....	......	....	+1 10.17	+0.01	+1 10.18	....	−0.33
	6 27 32	9.8	5	+1 5.79	+0.03	+1 5.82	....	......	....	−0.283	......
	6 31 37	9.8	5	....	......	....	+1 2.46	+0.01	+1 2.47	....	−0.41
	6 52 16	9.8	5	....	......	....	+0 43.25	+0.01	+0 43.26	....	−0.57
	6 57 39	9.8	5	+1 8.17	+0.02	+1 8.19	....	......	....	−0.005	......
	7 2 28	9.8	5	....	......	....	+0 34.02	0.00	+0 34.02	....	−0.64
	7 7 56	9.8	5	+1 8.78	+0.02	+1 8.80	....	......	....	−0.178	......
	7 12 15	9.8	5	....	......	....	+0 24.76	0.00	+0 24.76	....	−0.70
	7 24 9	9.8	5	....	......	....	+0 13.71	0.00	+0 13.71	....	−0.76
	7 28 59	9.8	5	+1 10.15	+0.02	+1 10.17	....	......	....	−0.120	......
	7 33 29	9.8	5	....	......	....	+0 4.81	0.00	+0 4.81	....	−0.79
	7 44 7	9.8	5	....	......	....	−0 5.11	0.00	−0 5.11	....	−0.82
	7 48 54	9.8	5	+1 11.84	+0.02	+1 11.86	....	......	....	−0.064	......
	7 53 10	9.8	5	....	......	....	−0 13.58	−0.01	−0 13.59	....	−0.84
	8 13 42	9.8	5	....	......	....	−0 33.15	−0.01	−0 33.16	....	−0.86
	8 18 11	9.8	5	+1 13.99	+0.02	+1 14.01	....	......	....	+0.017	......
	8 22 12	9.8	5	....	......	....	−0 41.24	−0.01	−0 41.25	....	−0.86
	12 53 18	...	5	....	......	....	−0 13.34	−0.05	−0 13.39	....	+2.35
	12 58 5	...	5	−1 39.55	−0.06	−1 39.61	....	......	....	+0.614	......
	13 4 19	...	5	....	......	....	−0 24.94	−0.06	−0 25.00	....	+2.57
	13 11 4	...	5	−1 37.81	−0.06	−1 37.87	....	......	....	+0.625	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90 Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Dec. 8	13h 17m 11s	....	5	....	......	....	−0′ 37″.75	−0″.07	−0′ 37″.82	....	+2″.84
	13 23 35	....	5	−1′ 35″.94	−0″.06	−1′ 36″.00	....	......	....	+0s.633	......
	13 29 55	....	5	....	......	....	−0 50.77	−0.07	−0 50.81	....	+3.10
	13 46 18	....	5	....	......	....	−1 7.09	−0.09	−1 7.18	....	+3.43
	13 50 32	11	5	....	......	....	+2 35.67	+0.10	+2 35.77	....	+3.54
	13 57 6	....	5	−1 30.62	−0.07	−1 30.69	....	......	....	+0.615	......
	14 1 55	11	5	+0 51.13	+0.03	+0 51.16	....	......	....	+0.646	......
	14 8 23	....	5	....	......	....	−1 29.89	−0.12	−1 30.01	....	+3.90
	14 12 52	11	5	....	......	....	+2 12.96	+0.11	+2 13.07	....	+4.00
	14 21 40	....	5	....	......	....	−1 43.36	−0.14	−1 43.50	....	+4.19
	14 28 4	....	5	−1 25.49	−0.08	−1 25.57	....	......	....	+0.645	......
	14 34 8	....	5	....	......	....	−1 56.01	−0.16	−1 56.17	....	+4.44
	14 47 36	....	5	....	......	....	−2 8.72	−0.18	−2 8.90	....	+4.74
	14 52 51	....	5	−1 21.01	−0.11	−1 21.12	....	......	....	+0.636	......
	14 58 33	....	5	....	......	....	−2 20.72	−0.21	−2 20.93	....	+4.97
Dec. 9	5 19 26	1	5	....	......	....	−1 8.97	−0.03	−1 9.00	....	+0.47
	5 24 26	2	5	....	......	....	+2 49.60	+0.04	+2 49.64	....	+0.40
	5 28 35	3	5	....	......	....	−0 43.08	−0.03	−0 43.11	....	+0.33
	5 32 25	1	5	+0 52.44	+0.01	+0 52.45	....	......	....	−0.405	......
	5 36 5	2	5	+0 56.30	+0.05	+0 56.35	....	......	....	−0.397	......
	5 39 41	3	5	+2 2.24	+0.04	+2 2.28	....	......	....	−0.388	......
	5 45 2	1	5	....	......	....	−1 33.12	−0.03	−1 33.15	....	+0.12
	5 49 14	2	5	....	......	....	+2 26.49	+0.03	+2 26.52	....	+0.07
	5 53 27	3	5	....	......	....	−1 6.37	−0.04	−1 6.41	....	+0.02
	6 12 48	1	5	....	......	....	−1 58.10	−0.04	−1 58.14	....	−0.17
	6 17 20	2	5	....	......	....	+2 0.90	+0.03	+2 0.93	....	−0.21
	6 21 18	3	5	....	......	....	−1 31.72	−0.04	−1 31.76	....	−0.25
	6 26 26	1	5	+0 59.26	0.00	+0 59.26	....	......	....	−0.278	......
	6 30 4	2	5	+1 2.77	+0.03	+1 2.80	....	......	....	−0.268	......
	6 33 37	3	5	+1 58.96	+0.03	+1 58.99	....	......	....	−0.258	......
	6 40 20	1	5	....	......	....	−2 24.00	−0.05	−2 24.05	....	−0.43
	6 44 37	2	5	....	......	....	+1 35.15	+0.02	+1 35.17	....	−0.47
	6 49 13	3	5	....	......	....	−1 57.93	−0.04	−1 57.97	....	−0.50
	7 18 26	1	5	....	......	....	−2 59.62	−0.05	−2 59.67	....	−0.67
	7 23 18	2	5	....	......	....	+0 58.50	+0.01	+0 58.51	....	−0.69
	7 27 33	3	5	....	......	....	−2 33.88	−0.05	−2 33.93	....	−0.71
	7 33 29	1	5	+1 7.18	+0.01	+1 7.19	....	......	....	−0.098	......
	7 37 35	2	5	+1 10.95	+0.02	+1 10.97	....	......	....	−0.086	......
	7 42 0	3	5	+2 7.24	+0.03	+2 7.27	....	......	....	−0.075	......
	7 48 4	2	5	....	......	....	+0 31.87	+0.01	+0 34.88	....	−0.76
	7 52 27	1	5	....	......	....	−3 31.89	−0.06	−3 31.95	....	−0.77
	7 56 50	3	5	....	......	....	−3 1.82	−0.05	−3 1.87	....	−0.78
	8 3 40	2	5	....	......	....	+0 20.26	+0.01	+0 20.27	....	−0.78
	8 8 0	2	5	+1 14.52	+0.02	+1 14.54	....	......	....	−0.003	......
	8 12 47	2	5	....	......	....	+0 11.40	0.00	+0 11.40	....	−0.78
	14 58 35	11.5	5	....	......	....	+3 0.64	+0.24	+3 0.88	....	+5.06
	15 3 27	11.5	5	+1 0.21	+0.12	+1 0.33	....	......	....	+0.634	......
	15 11 4	11.5	6	....	......	....	+2 47.84	+0.28	+2 48.12	....	+5.30
	15 26 36	11.5	5	....	......	....	+2 32.28	+0.33	+2 32.61	....	+5.62
	15 31 30	11.5	5	+1 7.21	+0.19	+1 7.40	....	......	....	+0.599	......
	15 36 54	11.5	5	....	......	....	+2 20.97	+0.37	+2 21.34	....	+5.81
	15 46 1	11.5	5	....	......	....	+2 11.68	+0.41	+2 12.09	....	+5.99
	15 51 28	11.5	4	+1 12.88	+0.26	+1 13.14	....	......	....	+0.578	......
Dec. 10	5 21 52	1	5	....	......	....	+1 26.51	+0.03	+1 26.51	....	+0.42
	5 25 48	2	5	....	......	....	−1 55.34	−0.03	−1 55.37	....	+0.37
	5 30 18	1	5	−0 32.92	0.00	−0 32.92	....	......	....	−0.398	......
	5 34 20	2	5	−0 36.86	−0.03	−0 36.89	....	......	....	−0.389	......
	5 39 22	1	5	....	......	....	+1 10.30	+0.02	+1 10.32	....	+0.20
	5 43 44	2	5	....	......	....	−2 12.40	−0.03	−2 12.43	....	+0.14
	5 57 5	1	5	....	......	....	+0 53.25	+0.02	+0 53.27	....	0.00
	6 1 23	2	4	....	......	....	−2 28.23	−0.04	−2 28.27	....	−0.05
	6 6 46	1	5	−0 16.56	0.00	−0 16.56	....	......	....	−0.316	......
	6 11 1	2	5	−0 20.42	−0.03	−0 20.45	....	......	....	−0.304	......
	6 15 43	1	5	....	......	....	+0 35.92	+0.01	+0 35.93	....	−0.20
	6 19 6	2	5	....	......	....	−2 45.40	−0.04	−2 45.44	....	−0.23
	6 49 51	1	5	....	......	....	+0 3.78	0.00	+0 3.78	....	−0.48
	6 54 28	1	5	−0 8.92	0.00	−0 8.92	....	......	....	−0.195	......
	6 58 52	1	5	....	......	....	−0 5.06	0.00	−0 5.06	....	−0.54
	7 1 35	1	5	....	......	....	−0 10.57	0.00	−0 10.57	....	−0.57

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Dec. 10	7ʰ 8ᵐ 11ˢ	1	5	−0′ 6ˢ.46	0ˢ.00	−0′ 6ˢ.46	...	...	...	−0ˢ.156	...
	7 12 19	1	5	...	...	...	−0′ 18″.06	0″.00	−0′ 18″.06	...	−0″.61
	7 42 25	1	5	...	...	...	−0 47.34	−0.01	−0 47.35	...	−0.71
	7 47 57	1	5	−0 0.82	0.00	−0 0.82	...	...	...	−0.047	...
	7 52 32	1	5	...	...	...	−0 57.23	−0.02	−0 57.25	...	−0.72
Dec. 11	5 2 0	10.5	5	...	...	...	−0 11.07	−0.01	−0 11.08	...	+0.72
	5 6 14	10.5	5	+0 13.45	0.00	+0 13.45	...	...	...	−0.441	...
	5 11 34	10.5	5	+0 14.70	0.00	+0 14.70	...	...	...	−0.431	...
	5 15 49	10.5	5	...	...	...	−0 24.02	−0.01	−0 24.03	...	+0.54
	5 29 5	10.5	5	...	...	...	−0 36.78	−0.01	−0 36.79	...	+0.36
	5 33 20	10.5	5	+0 19.68	0.00	+0 19.68	...	...	...	−0.384	...
	5 36 34	10.5	5	+0 20.43	0.00	+0 20.43	...	...	...	−0.377	...
	5 41 28	10.5	5	...	...	...	−0 48.38	−0.02	−0 48.40	...	+0.21
	6 0 35	10.5	5	...	...	...	−1 6.60	−0.02	−1 6.62	...	+0.02
	6 6 11	10.5	5	+0 26.73	0.00	+0 26.73	...	...	...	−0.308	...
	6 10 10	10.5	5	+0 27.73	0.00	+0 27.73	...	...	...	−0.298	...
	6 14 40	10.5	5	...	...	...	−1 19.98	−0.03	−1 20.01	...	−0.15
	6 38 54	10.5	5	...	...	...	−1 43.11	−0.03	−1 43.14	...	−0.35
	6 44 31	10.5	5	+0 35.26	0.00	+0 35.26	...	...	...	−0.213	...
	6 48 23	10.5	5	+0 36.02	0.00	+0 36.02	...	...	...	−0.203	...
	6 54 16	10.5	7	...	...	...	−1 57.93	−0.04	−1 57.97	...	−0.46
	7 15 8	10.5	5	...	...	...	−2 18.22	−0.04	−2 18.26	...	−0.57
	7 21 26	10.5	5	+0 42.85	+0.01	+0 42.86	...	...	...	−0.115	...
	7 26 58	10.5	5	...	...	...	−2 29.80	−0.04	−2 29.84	...	−0.61
	13 51 8	1	5	...	...	...	−2 2.61	−0.14	−2 2.75	...	+3.83
	13 55 54	2	5	...	...	...	+3 47.32	+0.05	+3 47.37	...	+3.89
	14 2 4	1	5	−1 46.70	−0.09	−1 46.79	...	...	...	+0.632	...
	14 6 42	2	5	−1 16.56	−0.08	−1 16.64	...	...	...	+0.631	...
	14 12 39	1	5	...	...	...	−2 25.15	−0.19	−2 25.34	...	+4.29
	14 16 51	2	5	...	...	...	+3 25.12	+0.06	+3 25.18	...	+4.37
	14 31 37	1	5	...	...	...	−2 45.18	−0.24	−2 45.42	...	+4.62
	14 35 33	2	5	...	...	...	+3 5.52	+0.07	+3 5.59	...	+4.70
	14 41 31	1	5	−1 34.53	−0.14	−1 34.67	...	...	...	+0.622	...
	14 45 39	2	5	−1 4.16	−0.05	−1 4.21	...	...	...	+0.621	...
	14 51 35	1	5	...	...	...	−3 6.21	−0.28	−3 6.49	...	+5.06
	14 55 53	2	5	...	...	...	+2 44.11	+0.08	+2 44.79	...	+5.16
	15 25 7	2	5	...	...	...	+2 13.57	+0.11	+2 13.68	...	+5.75
	15 31 25	2	5	−0 48.22	+0.01	−0 48.21	...	...	...	+0.584	...
	15 37 48	2	5	...	...	...	+2 0.29	+0.12	+2 0.41	...	+5.98
Dec. 12	4 58 29	1	5	...	...	...	−1 21.50	−0.01	−1 21.51	...	+0.78
	5 3 44	1	5	−1 35.77	−0.05	−1 35.82	...	...	...	−0.436	...
	5 8 56	1	5	...	...	...	−1 31.67	−0.01	−1 31.68	...	+0.63
	5 13 23	2	5	...	...	...	+1 14.68	+0.04	+1 14.72	...	+0.58
	5 17 44	1	5	...	...	...	−1 39.87	−0.01	−1 39.88	...	+0.51
	5 22 45	2	5	−1 36.55	−0.03	−1 36.58	...	...	...	−0.394	...
	5 26 44	1	5	−1 29.41	−0.05	−1 29.46	...	...	...	−0.385	...
	5 31 12	3	5	−0 6.07	0.00	−0 6.07	...	...	...	−0.377	...
	5 35 41	1	5	...	...	...	−1 56.99	−0.03	−1 57.02	...	+0.29
	5 39 31	2	5	...	...	...	+0 49.42	+0.03	+0 49.45	...	+0.24
	5 42 51	3	5	...	...	...	+0 24.98	+0.01	+0 24.99	...	+0.20
	5 51 32	1	5	−1 22.68	−0.04	−1 22.72	...	...	...	−0.333	...
	5 54 57	2	5	−1 27.85	−0.03	−1 27.88	...	...	...	−0.323	...
	5 59 56	3	5	+0 0.81	0.00	+0 0.81	...	...	...	−0.312	...
	6 5 48	1	5	...	...	...	−2 26.07	−0.03	−2 26.10	...	−0.03
	6 9 52	2	5	...	...	...	+0 20.17	+0.02	+0 20.19	...	−0.09
	6 13 16	3	5	...	...	...	−0 4.29	0.00	−0 4.29	...	−0.12
	6 40 10	1	5	...	...	...	−2 59.50	−0.05	−2 59.55	...	−0.33
	6 44 55	2	5	...	...	...	−0 13.66	0.00	−0 13.66	...	−0.36
	6 48 58	3	5	...	...	...	−0 38.77	−0.01	−0 38.78	...	−0.39
	6 53 55	1	5	−1 6.63	−0.03	−1 6.66	...	...	...	−0.175	...
	6 57 48	2	5	−1 11.17	−0.02	−1 11.19	...	...	...	−0.164	...
	7 1 36	3	5	+0 17.63	0.00	+0 17.63	...	...	...	−0.157	...
	7 7 0	1	5	...	...	...	−3 26.04	−0.06	−3 26.10	...	−0.46
	7 10 59	2	5	...	...	...	−0 39.52	−0.01	−0 39.53	...	−0.50
	7 14 48	3	5	...	...	...	−1 4.50	−0.02	−1 4.52	...	−0.51
	7 30 18	1	5	...	...	...	−3 48.46	−0.06	−3 48.52	...	−0.57
	7 34 57	2	5	...	...	...	−1 3.31	−0.02	−1 3.33	...	−0.58
	7 39 16	3	5	...	...	...	−1 28.56	−0.03	−1 28.59	...	−0.59
	7 44 55	1	5	+0 53.71	+0.01	+0 53.72	...	...	...	−0.038	...

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90 Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Dec.12	7ʰ 19ᵐ 33ˢ	2	5	+0′ 58″00	+0″02	+0′ 58″02	....	......	....	−0ˢ027	......
	7 53 26	3	5	−0 30.53	−0.01	−0 30.51	....	......	....	−0.017	......
	8 0 16	1	5	....	......	....	−4′ 18″54	−0″08	−4 18″62	....	−0″61
	8 5 26	2	5	....	......	....	−1 33.30	−0.03	−1 33.33	....	−0.60
	8 9 25	3	5	....	......	....	−1 58.88	−0.03	−1 58.91	....	−0.60
Dec.17	8 57 8	1	5	....	......	....	−1 37.72	−0.03	−1 37.75	....	−0.07
	9 1 4	2	5	....	......	....	−1 58.97	−0.04	−1 59.01	....	−0.05
	9 7 3	1	5	+0 6.16	+0.01	+0 6.17	....	......	....	+0.214	......
	9 9 48	2	1	−1 49.98	−0.02	−1 50.00	....	......	....	+0.224	......
Dec.18	4 55 15	1	5	....	......	....	−0 30.88	0.00	−0 30.88	....	+0.91
	4 58 57	2	5	....	......	....	+0 8.28	−0.03	+0 8.25	....	+0.87
	5 3 4	1	5	−0 29.16	−0.01	−0 29.17	....	......	....	−0.384	......
	5 7 6	2	5	+2 56.91	+0.06	+2 56.97	....	......	....	−0.373	......
	5 11 52	1	5	....	......	....	−0 47.78	−0.01	−0 47.79	....	+0.70
	5 15 48	2	5	....	......	....	−0 8.78	−0.03	−0 8.81	....	+0.66
	5 20 33	3	5	....	......	....	+0 42.63	+0.01	+0 42.61	....	+0.60
	5 24 39	1	5	....	......	....	−1 0.68	−0.01	−1 0.69	....	+0.56
	5 28 28	2	5	....	......	....	−0 21.69	−0.03	−0 21.72	....	+0.51
	5 32 55	3	5	+0 23.41	+0.01	+0 23.42	....	......	....	−0.320	......
	5 36 54	2	5	+3 13.67	+0.06	+3 13.73	....	......	....	−0.311	......
	5 41 5	3	4	....	......	....	+0 21.78	0.00	+0 21.78	....	+0.39
	5 44 38	1	5	....	......	....	−1 20.83	−0.02	−1 20.85	....	+0.35
	5 48 38	1	5	−0 3.79	−0.01	−0 3.80	....	......	....	−0.284	......
	5 52 59	2	5	....	......	....	−0 46.94	−0.03	−0 46.97	....	+0.28
	6 35 52	1	5	....	......	....	−2 13.36	−0.01	−2 13.40	....	−0.03
	6 41 1	2	5	....	......	....	−1 36.15	−0.01	−1 36.19	....	−0.06
	6 46 31	1	5	+0 27.57	0.00	+0 27.57	....	......	....	−0.142	......
	6 52 36	2	5	+3 55.09	+0.06	+3 55.15	....	......	....	−0.127	......
	6 58 57	1	5	....	......	....	−2 37.14	−0.05	−2 37.19	....	−0.14
	7 3 3	2	5	....	......	....	−1 58.85	−0.04	−1 58.89	....	−0.15
	7 16 37	1	5	....	......	....	−2 55.60	−0.05	−2 55.65	....	−0.20
	7 21 13	2	5	....	......	....	−2 17.69	−0.04	−2 17.73	....	−0.20
	7 26 49	2	5	+4 13.11	+0.07	+4 13.18	....	......	....	−0.039	......
	7 31 22	1	5	+0 51.95	+0.01	+0 51.96	....	......	....	−0.026	......
	7 37 26	1	5	....	......	....	−3 17.21	−0.06	−3 17.27	....	−0.22
	7 41 26	2	5	....	......	....	−2 39.04	−0.05	−2 39.09	....	−0.22
	12 46 31	9	5	....	......	....	−1 32.15	+0.07	−1 32.08	....	+3.22
	12 51 37	9	5	+3 23.48	+0.16	+3 23.61	....	......	....	+0.586	......
	12 57 48	9	5	....	......	....	−1 41.81	+0.08	−1 41.73	....	+3.43
	13 59 46	9	5	....	......	....	−2 53.55	+0.14	−2 53.41	....	+3.47
	14 6 28	9	6	+4 11.85	+0.26	+4 12.11	....	......	....	+0.595	......
	14 12 43	9	5	....	......	....	−3 8.10	+0.15	−3 7.95	....	+3.72
	14 20 59	12	5	....	......	....	−1 54.84	−0.20	−1 55.04	....	+3.88
	14 27 28	12	5	−0 57.28	−0.13	−0 57.41	....	......	....	+0.587	......
	14 33 15	12	5	....	......	....	−2 8.72	−0.23	−2 8.95	....	+4.13
	14 45 34	9	5	....	......	....	−3 44.32	+0.18	−3 44.14	....	+4.37
	14 53 47	9	5	+4 42.91	+0.32	+4 43.23	....	......	....	+0.570	......
	15 2 4	9	6	....	......	....	−4 2.66	+0.20	−1 2.46	....	+4.68
Dec.19	5 6 24	1	5	....	......	....	+0 18.45	0.00	+0 18.15	....	+0.81
	5 11 0	1	5	+0 16.18	+0.01	+0 16.19	....	......	....	−0.360	......
	5 14 58	1	5	....	......	....	+0 9.88	0.00	+0 9.88	....	+0.70
	5 21 0	2	5	....	......	....	−0 26.91	−0.03	−0 26.94	....	+0.61
	5 27 0	1	6	....	......	....	−0 2.21	0.00	−0 2.24	....	+0.57
	5 32 26	2	5	+2 42.30	+0.05	+2 42.35	....	......	....	−0.313	......
	5 36 3	1	5	+0 31.34	+0.01	+0 31.35	....	......	....	−0.307	......
	5 40 14	2	5	....	......	....	−0 46.47	−0.03	−0 46.50	....	+0.44
	5 43 54	1	5	....	......	....	−0 19.49	−0.01	−0 19.50	....	+0.41
	6 0 0	1	5	....	......	....	−0 36.05	−0.01	−0 36.06	....	+0.26
	6 4 2	1	5	+0 48.02	+0.01	+0 48.03	....	......	....	−0.242	......
	6 7 58	1	5	....	......	....	−0 44.23	−0.02	−0 44.25	....	+0.18
	6 31 8	1	5	....	......	....	−1 8.20	−0.02	−1 8.22	....	+0.04
	6 36 6	3	5	....	......	....	+2 42.73	+0.04	+2 42.77	....	+0.02
	6 41 47	1	5	+1 9.92	+0.02	+1 9.94	....	......	....	−0.149	......
	6 45 14	3	5	+0 45.37	+0.02	+0 45.39	....	......	....	−0.139	......
	6 49 55	1	5	....	......	....	−1 27.73	−0.03	−1 27.76	....	−0.05
	6 53 56	3	5	....	......	....	+2 24.10	+0.04	+2 24.14	....	−0.07
	7 13 15	3	5	....	......	....	+2 4.01	+0.03	+2 4.07	....	−0.28
	7 18 12	1	5	....	......	....	−4 57.18	−0.01	−1 57.22	....	−0.29

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date 1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Dec.19	7ʰ 23ᵐ 39ˢ	3	5	+1′ 8ˢ.15	+0ˢ.02	+1′ 8ˢ.17	....	......	....	−0ˢ.042	......
	7 27 54	1	5	+1 37.29	+0.03	+1 37.32	....	......	....	−0.031	......
	7 33 19	3	5	....	......	....	+1′ 42″.73	+0″.03	+1′ 42″.76	....	−0″.31
	7 37 28	1	5	....	......	....	−2 17.38	−0.04	−2 17.42	....	−0.31
	12 47 48	1	5	....	......	....	+0 36.40	+0.07	+0 36.47	....	+3.31
	12 52 36	2	5	....	......	....	+1 0.58	+0.04	+1 0.62	....	+3.41
	12 57 38	3	5	....	......	....	+0 43.74	+0.01	+0 43.75	....	+3.53
	13 1 44	4	5	....	......	....	+1 16.32	−0.01	+1 16.31	....	+3.59
	13 7 21	1	5	+2 0.54	+0.10	+2 0.64	....	......	....	+0.590	......
	13 12 35	2	5	+0 44.39	+0.04	+0 44.43	....	......	....	+0.592	......
	13 16 38	3	5	−0 7.68	−0.01	−0 7.69	....	......	....	+0.593	......
	13 20 46	4	5	−0 55.94	−0.05	−0 55.99	....	......	....	+0.593	......
	13 26 43	1	5	....	......	....	−0 7.61	+0.11	−0 7.50	....	+4.07
	13 31 25	3	5	....	......	....	+0 5.83	+0.01	+0 5.84	....	+4.17
	13 36 1	2	5	....	......	....	+0 11.77	+0.06	+0 11.83	....	+4.25
	13 39 55	4	5	....	......	....	+0 33.44	−0.02	+0 33.42	....	+4.32
	13 48 7	1	5	+2 28.24	+0.15	+2 28.39	....	......	....	+0.595	......
	13 53 14	2	5	+1 11.91	+0.08	+1 11.99	....	......	....	+0.594	......
	13 57 46	3	5	+0 20.36	+0.02	+0 20.38	....	......	....	+0.593	......
	14 1 52	4	5	−0 27.60	−0.03	−0 27.63	....	......	....	+0.593	......
	14 8 19	3	5	....	......	....	−0 35.44	+0.01	−0 35.43	....	+4.88
	14 12 25	4	5	....	......	....	−0 3.01	−0.03	−0 3.04	....	+4.97
	14 17 58	3	5	+0 34.56	+0.03	+0 34.59	....	......	....	+0.587	......
	14 21 35	4	5	−0 13.40	−0.02	−0 13.42	....	......	....	+0.585	......
	14 25 28	3	5	....	......	....	−0 54.62	0.00	−0 54.62	....	+5.21
	14 29 13	4	5	....	......	....	−0 21.31	−0.03	−0 21.37	....	+5.29
Dec.20	6 4 37	.	4	....	......	....	+1 39.11	0.00	+1 39.11	....	+0.26
	7 35 52	.	1	−2 12.69	−0.04	−2 12.73	....	......	....	−0.003	......
Dec.21	13 47 33	1	5	....	......	....	−0 14.22	+0.16	−0 14.06	....	+4.64
	13 53 53	2	5	....	......	....	+0 21.31	+0.21	+0 21.52	....	+4.75
	14 0 10	1	5	+3 8.37	+0.21	+3 8.58	....	......	....	+0.583	......
	14 4 53	2	6	+3 26.01	+0.25	+3 26.26	....	......	....	+0.582	......
	14 11 49	1	5	....	......	....	−0 42.32	+0.20	−0 42.12	....	+5.09
	14 16 40	2	5	....	......	....	−0 5.38	+0.30	−0 5.08	....	+5.19
Dec.24	13 27 37	1	5	....	......	....	+2 11.15	+0.22	+2 11.37	....	+4.47
	13 31 46	2	5	....	......	....	+3 24.03	+0.21	+3 21.24	....	+4.55
	13 37 50	1	5	+2 34.48	+0.20	+2 34.68	....	......	....	+0.573	......
	13 42 41	2	5	+1 27.12	+0.15	+1 27.27	....	......	....	+0.572	......
	13 47 51	1	5	+2 43.21	+0.23	+2 43.44	....	......	....	+0.571	......
	13 52 16	2	5	+1 35.71	+0.18	+1 35.89	....	......	....	+0.570	......
	13 57 45	1	6	....	......	....	−1 36.94	+0.32	+1 37.26	....	+5.03
	14 5 31	2	7	....	......	....	+2 45.83	+0.34	+2 46.17	....	+5.17
Dec.26	5 57 36	13	5	....	......	....	−3 33.17	−0.06	−3 33.23	....	+0.59
	6 3 24	13	5	−0 37.46	−0.02	−0 37.48	....	......	....	−0.197	......
	6 10 42	13	5	....	......	....	−3 46.84	−0.06	−3 46.90	....	+0.51
	6 31 35	13	5	....	......	....	−4 9.51	−0.07	−4 9.58	....	+0.40
	6 39 29	13	5	−0 5.20	−0.01	−0 5.21	....	......	....	−0.111	......
	6 46 34	13	5	....	......	....	−4 25.08	−0.08	−4 25.16	....	+0.35
Dec.28	5 20 32	1	5	....	......	....	+4 40.66	+0.09	+4 40.75	....	+1.00
	5 25 20	2	5	....	......	....	−0 4.13	−0.01	−0 4.14	....	+0.94
	5 32 46	1	5	−1 1.09	0.00	−1 1.09	....	......	....	−0.255	......
	5 36 53	2	5	+1 16.36	+0.02	+1 16.38	....	......	....	−0.246	......
	5 43 18	1	5	....	......	....	+4 17.02	+0.08	+4 17.10	....	+0.81
	5 47 50	2	5	....	......	....	−0 27.78	−0.01	−0 27.79	....	+0.78
	6 18 12	1	5	....	......	....	+3 40.23	+0.06	+3 40.29	....	+0.60
	6 23 13	2	5	....	......	....	−1 5.14	−0.02	−1 5.16	....	+0.57
	6 29 31	1	5	−0 4.95	+0.01	−0 4.94	....	......	....	−0.118	......
	6 34 19	2	5	+2 13.70	+0.04	+2 13.74	....	......	....	−0.114	......
	6 41 17	1	5	....	......	....	+3 15.78	+0.06	+3 15.81	....	+0.50
	6 45 22	2	5	....	......	....	−1 28.55	−0.03	−1 28.58	....	+0.49
	7 2 19	1	5	....	......	....	+2 53.32	+0.05	+2 53.37	....	+0.45
	7 7 58	1	5	+0 33.59	+0.01	+0 33.60	....	......	....	−0.032	......
	7 12 56	1	5	....	......	....	+2 41.61	+0.05	+2 41.66	....	+0.44
	11 14 51	8	5	....	......	....	+2 18.81	+0.11	+2 18.92	....	+2.43
	11 21 7	8	5	+3 36.20	+0.10	+3 36.30	....	......	....	+0.487	......
	11 28 30	8	5	....	......	....	+2 3.59	+0.12	+2 3.71	....	+2.63

MICROMETRICAL OBSERVATIONS OF *EROS* — *Continued*

Date—1900	90 Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Dec.28	11h 45m 17s	13	5	...	...	...	−0′ 5″.98	−0″.01	−0′ 5″.99	...	+2″.91
	11 50 52	13	5	−0′ 10″.09	−0″.01	−0′ 10″.10	...	...	...	+0s.509	...
	11 55 11	13	5	...	...	...	−0 17.16	−0.01	−0 17.17	...	+3.07
	12 7 43	8	5	...	...	...	+1 18.71	+0.16	+1 18.87	...	+3.29
	12 12 3	13	5	...	...	...	−0 35.95	−0.01	−0 35.96	...	+3.36
	12 18 2	8	5	+4 35.78	+0.19	+4 35.97	...	...	...	+0.541	...
	12 23 17	13	5	+0 21.30	+0.02	+0 21.32	...	...	...	+0.544	...
	12 28 42	8	5	...	...	...	+0 55.78	+0.18	+0 55.96	...	+3.66
	12 33 9	13	5	...	...	...	−1 0.64	−0.01	−1 0.65	...	+3.73
Dec.29	5 26 24	9.5	5	...	...	...	+4 37.13	+0.07	+4 37.20	...	+1.01
	5 31 51	9.5	5	+2 32.12	+0.06	+2 32.18	...	...	...	−0.250	...
	5 38 40	9.5	5	...	...	...	+4 24.19	+0.07	+4 24.26	...	+0.90
	5 56 40	1	5	...	...	...	+1 26.60	+0.03	+1 26.63	...	+0.77
	6 1 11	2	5	...	...	...	−0 22.88	0.00	−0 22.88	...	+0.75
	6 6 26	1	5	+0 6.46	0.00	+0 6.46	...	...	...	−0.174	...
	6 11 1	2	6	−1 25.81	−0.02	−1 25.83	...	...	...	−0.162	...
	6 17 11	1	5	...	...	...	+1 4.82	+0.01	+1 4.83	...	+0.67
	6 21 6	2	5	...	...	...	−0 44.09	−0.01	−0 44.10	...	+0.65
	6 39 51	9.5	5	...	...	...	+3 19.55	+0.05	+3 19.60	...	+0.58
	6 46 23	9.5	5	+3 48.94	+0.07	+3 49.01	...	...	...	−0.080	...
	6 53 28	9.5	5	...	...	...	+3 4.75	+0.05	+3 4.80	...	+0.54
	7 6 41	9.5	5	...	...	...	+2 50.31	+0.05	+2 50.36	...	+0.52
	7 12 43	9.5	5	+4 16.28	+0.07	+4 16.35	...	...	...	−0.014	...
	7 19 11	9.5	5	...	...	...	+2 37.11	+0.04	+2 37.15	...	+0.52
Dec.30	5 29 15	1	5	...	...	...	−3 10.94	−0.06	−3 11.00	...	+1.05
	5 34 24	2	5	...	...	...	−0 54.51	−0.04	−0 55.55	...	+1.00
	5 39 43	1	5	+0 44.26	0.00	+0 44.26	...	...	...	−0.229	...
	5 41 1	2	5	+4 4.26	+0.07	+4 4.33	...	...	...	−0.218	...
	5 50 20	1	5	...	...	...	−3 33.28	−0.07	−3 33.35	...	+0.88
	5 54 25	2	5	...	...	...	−1 15.83	−0.04	−1 15.87	...	+0.86
	6 43 8	1	3	...	...	...	−1 29.76	−0.08	−1 29.81	...	+0.63
Dec.31	5 45 18	9.5	5	...	...	...	+4 21.94	+0.08	+4 22.02	...	+0.94
	5 53 21	9.5	5	−0 52.13	0.00	−0 52.13	...	...	...	−0.196	...
	6 0 9	9.5	5	...	...	...	+4 6.15	+0.07	+4 6.22	...	+0.84
	6 38 29	9.5	5	...	...	...	+3 25.44	+0.06	+3 25.50	...	+0.68
	6 45 1	9.5	5	+0 6.34	+0.01	+0 6.35	...	...	...	−0.074	...
	6 51 25	9.5	5	...	...	...	+3 11.80	+0.05	+3 11.85	...	+0.65
	7 2 59	9.5	5	...	...	...	+2 59.40	+0.05	+2 59.45	...	+0.12
	7 8 57	9.5	5	+0 31.43	+0.01	+0 31.44	...	...	...	−0.017	...
	7 15 4	9.5	5	...	...	...	+2 46.47	+0.05	+2 46.52	...	+0.12
	8 57 31	9.5	5	...	...	...	+0 54.96	+0.03	+0 54.99	...	+1.01
	9 3 43	9.5	5	+2 41.56	+0.05	+2 41.61	...	...	...	+0.248	...
	9 10 22	9.5	5	...	...	...	+0 40.82	+0.03	+0 40.85	...	+1.11
	9 30 7	9.5	5	...	...	...	+0 19.10	+0.03	+0 19.13	...	+1.30
	9 38 19	9.5	5	+3 20.53	+0.07	+3 20.60	...	...	...	+0.322	...
	9 45 0	9.5	6	...	...	...	+0 2.54	+0.03	+0 2.57	...	+1.45
	10 36 11	9.5	5	...	...	...	−0 54.61	+0.04	−0 54.57	...	+2.06
	10 43 9	9.5	5	+4 35.33	+0.13	+4 35.46	...	...	...	+0.435	...
	10 49 30	9.5	5	...	...	...	−1 9.67	+0.05	−1 9.62	...	+2.25
	12 43 59	12.5	5	...	...	...	+2 59.74	+0.10	+2 59.84	...	+4.10
	12 51 4	12.5	5	+0 12.07	+0.03	+0 12.10	...	...	...	+0.549	...
	12 57 10	12.5	5	...	...	...	+2 45.05	+0.12	+2 45.17	...	+4.33
1901 Jan.1	5 42 41	1	5	...	...	...	−1 38.51	−0.02	−1 38.53	...	+1.01
	5 48 8	1	5	−2 39.81	−0.05	−2 39.86	...	...	...	−0.201	...
	5 54 11	1	5	...	...	...	−1 50.63	−0.02	−1 50.65	...	+0.93
	5 59 53	2	5	...	...	...	−4 22.32	−0.08	−4 22.40	...	+0.91
	6 5 30	2	5	+1 5.90	−0.08	+1 5.82	...	...	...	−0.163	...
	6 11 50	2	5	...	...	...	−1 34.99	−0.08	−1 35.07	...	+0.85
	6 55 15	1	5	...	...	...	−2 55.91	−0.05	−2 55.96	...	+0.71
	7 0 44	1	5	−1 15.56	−0.02	−1 15.58	...	...	...	−0.034	...
	7 7 20	1	5	...	...	...	−3 8.27	−0.05	−3 8.32	...	+0.70
	10 58 49	1	5	...	...	...	+0 55.77	+0.09	+0 55.86	...	+2.46
	11 3 40	2	5	...	...	...	+0 58.46	+0.06	+0 58.52	...	+2.54
	11 11 29	1	5	+1 14.07	+0.13	+1 14.20	...	...	...	+0.472	...
	11 15 37	2	5	+2 33.31	+0.10	+2 33.41	...	...	...	+0.477	...
	11 21 36	1	5	...	...	...	+0 30.22	+0.10	+0 30.32	...	+2.81
	11 24 55	2	5	...	...	...	+0 34.38	+0.07	+0 34.45	...	+2.87

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Jan. 1	12ʰ 43ᵐ 46ˢ	10	5	...	...	...	+1′ 56″.59	+0″.05	+1 56″.64	...	+4″.16
	12 49 46	10	6	−0′ 39″.48	−0″.01	−0′ 39″.49	...	...	...	+0ˢ.545	...
	12 56 11	10	5	...	...	...	+1 42.16	+0.05	+1 42.21	...	+4.37
	13 4 55	10	5	...	...	...	+1 32.68	+0.05	+1 32.73	...	+4.54
	13 10 8	10	5	−0 11 .94	+0.01	−0 11.93	...	...	...	+0.548	...
	13 15 51	10	6	...	...	...	+1 19.56	+0.06	+1 19.62	...	+4.72
	13 24 53	10	6	...	...	...	+1 9.96	+0.07	+1 10.03	...	+4.89
	13 30 19	10	5	+0 12.95	+0.05	+0 13.00	...	...	...	+0.457	...
	13 35 11	10	5	...	...	...	+0 57.98	+0.09	+0 58.07	...	+5.07
	13 45 12	10	5	...	...	...	+0 47.25	+0.10	+0 47.35	...	+5.23
	13 50 36	10	5	+0 34.15	+0.09	+0 34.24	...	...	...	+0.541	...
	13 57 19	10	5	...	...	...	+0 33.39	+0.12	+0 33.51	...	+5.44
Jan. 2	5 17 14	10.5	5	...	...	...	−3 13.20	−0.05	−3 13.25	...	+1.27
	5 23 23	10.5	5	−0 13.97	−0.02	−0 13.99	...	...	...	−0.251	...
	5 27 16	10.5	5	−0 9.25	−0.02	−0 9.27	...	...	...	−0.242	...
	5 32 52	10.5	5	...	...	...	−3 29.53	−0.06	−3 29.59	...	+1.15
	6 0 39	10.5	5	...	...	...	−3 58.81	−0.09	−3 58.90	...	+0.97
	6 6 38	10.5	5	+0 37.98	0.00	+0 37.98	...	...	...	−0.157	...
	6 10 15	10.5	5	+0 42.51	0.00	+0 42.51	...	...	...	−0.148	...
	6 15 46	10.5	5	...	...	...	−4 15.01	−0.09	−4 15.10	...	+0.90
	7 5 31	10.5	5	...	...	...	−5 8.07	−0.09	−5 8.16	...	+0.78
	7 14 24	10.5	5	+1 58.81	+0.03	+1 58.84	...	...	...	+0.002	...
	7 21 1	10.5	5	...	...	...	−5 24.68	−0.09	−5 24.77	...	+0.78
	12 42 24	10	5	...	...	...	+0 44.55	−0.03	+0 44.52	...	+4.17
	12 48 32	10	5	−0 58.91	−0.05	−0 58.96	...	...	...	+0.541	...
	12 53 15	10	5	−0 52.05	−0.05	−0 52.10	...	...	...	+0.542	...
	12 57 39	10	5	...	...	...	+0 27.20	−0.02	+0 27.18	...	+4.44
	13 10 8	10	5	...	...	...	+0 13.12	−0.02	+0 13.10	...	+4.65
	13 17 12	10	7	−0 20.92	−0.02	−0 20.94	...	...	...	+0.544	...
	13 22 55	10	5	−0 14.33	−0.02	−0 14.35	...	...	...	+0.544	...
	13 28 58	10	5	...	...	...	−0 8.28	−0.02	−0 8.30	...	+4.98
	13 35 4	10	5	...	...	...	−0 14.99	−0.01	−0 15.00	...	+5.10
	13 40 38	10	5	+0 7.96	0.00	+0 7.96	...	...	...	+0.540	...
	13 45 28	10	5	...	...	...	−0 26.36	−0.01	−0 26.37	...	+5.27
Jan. 3	5 29 14	1	5	...	...	...	+0 57.55	+0.01	+0 57.56	...	+1 21
	5 33 46	2	5	...	...	...	−2 52.00	−0.05	−2 52.05	...	+1.18
	5 39 37	1	5	+0 25.08	0.01	+0 25.09	...	...	...	−0.211	...
	5 43 33	2	4	+0 17.43	0.00	+0 17.43	...	...	...	−0.203	...
	5 48 12	1	5	...	...	...	+0 37.31	+0.01	+0 37.32	...	+1.08
	5 51 57	2	5	...	...	...	−3 11.65	−0.06	−3 11.71	...	+1.06
	6 21 25	1	3	...	...	...	+0 2.43	0.00	+0 2.43	...	+0.92
	6 23 5	1	est.	...	...	...	0 0.00	0.00	0 0.00	...	+0.92
	6 24 41	1	2	...	...	...	−0 1.06	0.00	−0 1.06	...	+0.91
	6 39 32	1	5	+1 38.88	+0.03	+1 38.91	...	...	...	−0.076	...
	6 43 54	1	5	...	...	...	−0 21.65	−0.01	−0 21.66	...	+0.86
	10 36 0	1	5	...	...	...	−0 33.68	−0.05	−0 33.73	...	+2.30
	10 40 19	2	5	...	...	...	+0 6.37	−0.02	+0 6.35	...	+2.35
	10 44 11	3	5	...	...	...	+1 22.16	+0.01	+1 22.17	...	+2.41
	10 48 2	4	5	...	...	...	+1 30.54	−0.01	+1 30.53	...	+2.46
	10 55 44	1	5	−2 7.51	−0.06	−2 7.57	...	...	...	+0.450	...
	11 0 31	2	5	−0 39.33	−0.02	−0 39.35	...	...	...	+0.457	...
	11 4 44	3	5	−1 11.28	−0.04	−1 11.32	...	...	...	+0.462	...
	11 9 6	4	5	−1 57.59	−0.07	−1 57.66	...	...	...	+0.468	...
	11 15 51	1	5	...	...	...	−1 18.25	−0.06	−1 18.31	...	+2.85
	11 19 36	2	5	...	...	...	−0 37.52	−0.02	−0 37.54	...	+2.91
	11 23 42	3	5	...	...	...	+0 37.69	−0.04	+0 37.65	...	+2.97
	11 27 30	4	5	...	...	...	+0 45.70	−0.02	+0 45.68	...	+3.03
	11 38 38	1	5	...	...	...	−1 43.96	−0.07	−1 44.03	...	+3 20
	11 42 59	2	5	...	...	...	−1 3.77	−0.02	−1 3.79	...	+3.26
	11 47 36	3	5	...	...	...	+0 10.62	0.00	+0 10.62	...	+3.34
	11 52 13	4	6	...	...	...	+0 18.00	−0.02	+0 17.98	...	+3 42
	11 59 39	3	est.	0 0.00	0.00	0 0.00	...	...	...	+0.516	...
	11 59 55	1	5	−0 44.37	−0.03	−0 44.40	...	...	...	+0.516	...
	12 6 0	2	5	+0 44.85	+0.03	+0 44.88	...	...	...	+0.521	...
	12 9 41	3	5	+0 12.86	+0.01	+0 12.87	...	...	...	+0.522	...
	12 13 52	4	5	−0 33.31	−0.03	−0 33.34	...	...	...	+0.525	...
	12 19 52	1	5	...	...	...	−2 30.25	−0.08	−2 30.33	...	+3.86
	12 24 0	2	5	...	...	...	−1 50.36	−0.01	−1 50 37	...	+3.95
	12 28 28	3	5	...	...	...	−0 34.75	+0.01	−0 31.71	...	+4.02

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1909	90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Jan. 3	12h 32m 6s	4	5	......	......	......	−0′ 26″.20	−0″.02	−0′ 26″.22	......	+4″.08
	12 58 7	3	5	......	......	......	−1 8.51	+0.03	−1 8.48	......	+4.53
	13 8 14	4	5	......	......	......	−1 6.95	−0.01	−1 6.96	......	+4.59
	13 13 31	3	5	+1′ 37″.17	+0″.10	+1′ 37″.27	......	......	......	+0s.512	......
	13 18 19	4	5	+0 50.85	+0.04	+0 50.89	......	......	......	+0.541	......
	13 26 35	3	4	......	......	......	−1 40.67	+0.05	−1 40.62	......	+5.00
Jan. 8	5 55 39	1	5	......	......	......	−1 42.37	−0.04	−1 42.41	......	+1.33
	6 2 7	1	6	+1 45.28	+0.03	+1 45.31	......	......	......	−0.147	......
	6 8 39	1	5	......	......	......	−1 56.18	−0.04	−1 56.22	......	+1.28
	6 14 5	2	5	......	......	......	+2 10.26	+0.04	+2 10.30	......	+1.27
	6 19 10	3	5	......	......	......	+0 7.47	+0.01	+0 7.48	......	+1.24
	6 24 28	2	5	−2 12.77	−0.03	−2 12.80	......	......	......	−0.096	......
	6 28 38	3	5	−3 5.65	−0.05	−3 5.70	......	......	......	−0.087	......
	6 33 48	2	5	......	......	......	+1 49.28	+0.03	+1 49.31	......	+1.19
	6 37 55	3	5	......	......	......	−0 12.54	0.00	−0 12.54	......	+1.18
	6 54 5	2	5	......	......	......	+1 27.61	+0.03	+1 27.64	......	+1.16
	6 59 36	3	5	......	......	......	−0 35.88	−0.02	−0 35.90	......	+1.15
	7 7 29	2	5	−1 12.19	−0.02	−1 12.21	......	......	......	+0.002	......
	7 11 0	3	5	−2 6.05	−0.04	−2 6.09	......	......	......	+0.009	......
	7 16 22	2	5	......	......	......	+1 3.67	+0.02	+1 3.69	......	+1.15
	7 19 40	3	5	......	......	......	−0 56.86	−0.02	−0 56.88	......	+1.16
	7 59 41	2	5	......	......	......	+0 16.80	+0.01	+0 16.81	......	+1.26
	8 4 10	3	5	......	......	......	−1 45.29	−0.03	−1 45.32	......	+1.27
	8 9 41	2	5	+0 15.75	0.00	+0 15.75	......	......	......	+0.143	......
	8 14 9	3	5	−0 36.69	−0.01	−0 36.70	......	......	......	+0.152	......
	8 18 46	2	5	......	......	......	−0 3.81	+0.01	−0 3.80	......	+1.33
	8 22 42	3	6	......	......	......	−2 5.36	−0.04	−2 5.40	......	+1.35
Jan.12	6 5 29	11	5	......	......	......	−2 3.08	−0.04	−2 3.12	......	+1.52
	6 10 47	11	6	−0 27.74	−0.01	−0 27.75	......	......	......	−0.114	......
	6 15 51	11	5	......	......	......	−2 14.44	−0.04	−2 14.48	......	+1.48
Jan.14	5 58 52	1	5	......	......	......	+0 3.21	−0.01	+0 3.20	......	+1.65
	6 3 49	2	5	......	......	......	−2 55.85	−0.05	−2 55.90	......	+1.63
	6 9 56	1	5	+4 22.32	+0.08	+4 22.40	......	......	......	−0.111	......
	6 14 39	2	5	−1 24.63	−0.02	−1 24.65	......	......	......	−0.102	......
	6 20 12	1	5	......	......	......	−0 19.29	−0.01	−0 19.30	......	+1.58
	6 24 44	2	5	......	......	......	−3 17.89	−0.06	−3 17.95	......	+1.57
	6 49 51	2	5	......	......	......	−3 44.39	−0.07	−3 44.46	......	+1.44
	6 57 49	2	5	−0 16.09	0.00	−0 16.09	......	......	......	−0.005	......
	7 2 34	2	5	......	......	......	−3 58.00	−0.07	−3 58.07	......	+1.43
	8 43 31	11.5	5	......	......	......	+1 2.24	+0.02	+1 2.26	......	+1.88
	8 49 10	11.5	5	+0 9.69	0.00	+0 9.69	......	......	......	+0.235	......
	8 54 21	11.5	5	......	......	......	+0 50.78	+0.02	+0 50.80	......	+1.95
	9 16 59	11.5	5	......	......	......	+0 26.01	+0.02	+0 26.03	......	+2.14
	9 23 32	11.5	5	+1 5.23	+0.02	+1 5.25	......	......	......	+0.301	......
	9 28 52	11.5	5	......	......	......	+0 13.38	+0.01	+0 13.39	......	+2.25
	9 47 23	11.5	5	......	......	......	−0 7.31	+0.02	−0 7.29	......	+2.43
	9 52 57	11.5	5	+1 52.50	+0.05	+1 52.55	......	......	......	+0.352	......
	9 58 28	11.5	5	......	......	......	−0 19.15	+0.02	−0 19.13	......	+2.55
	10 25 32	9	5	......	......	......	−1 21.26	−0.05	−1 21.31	......	+2.84
	10 30 53	9	5	−1 21.03	−0.03	−1 21.06	......	......	......	+0.409	......
	10 36 20	9	6	......	......	......	−1 33.20	−0.05	−1 33.25	......	+2.97
	10 53 31	9	5	......	......	......	−1 51.84	−0.05	−1 51.89	......	+3.19
	10 58 52	9	5	−0 35.22	0.00	−0 35.22	......	......	......	+0.444	......
	11 3 51	9	6	......	......	......	−2 3.29	−0.06	−2 3.35	......	+3.33
	11 55 4	9	5	......	......	......	−3 0.01	−0.06	−3 0.07	......	+4.01
	12 0 57	9	5	+1 7.82	+0.05	+1 7.87	......	......	......	+0.496	......
	12 6 18	9	5	......	......	......	−3 12.63	−0.06	−3 12.69	......	+4.20
	12 21 24	9	5	......	......	......	−3 32.61	−0.05	−3 32.66	......	+4.48
	12 30 10	9	5	+1 56.42	+0.08	+1 56.50	......	......	......	+0.508	......
	12 36 29	9	5	......	......	......	−3 46.03	−0.05	−3 46.08	......	+4.65
Jan.16	5 43 5	12	5	......	......	......	+0 19.42	+0.01	+0 19.43	......	+1.99
	5 48 48	12	5	−1 17.96	−0.02	−1 17.98	......	......	......	−0.152	......
	5 53 38	12	5	−1 9.71	−0.02	−1 9.73	......	......	......	−0.142	......
	5 59 4	12	5	......	......	......	+0 2.72	0.00	+0 2.72	......	+1.92
	6 1 6	12	1	......	......	......	−0 2.47	0.00	−0 2.47	......	+1.90
	6 22 30	12	5	......	......	......	−0 21.69	−0.01	−0 21.70	......	+1.70
	6 26 57	12	5	−0 14.11	0.00	−0 14.11	......	......	......	−0.071	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90″ Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Jan.16	6h 31m 35s	12	5	......	......	......	−0′ 31″.13	−0″.01	−0′ 31″.14	......	+1″.68
	6 49 40	12	5	......	......	......	−0 50.50	−0.01	−0 50.51	......	+1.66
	6 54 43	12	5	+0′ 31″.49	+0″.01	+0′ 31″.50	......	......	......	−0s.011	......
	6 59 33	12	5	......	......	......	−1 0.64	−0.02	−1 0.66	......	+1.65
	7 8 24	12	5	......	......	......	−1 10.33	−0.02	−1 10.35	......	+1.66
	7 12 39	12	5	+1 1.28	+0.02	+1 1.30	......	......	......	+0.029	......
	7 16 57	12	5	......	......	......	−1 19.05	−0.02	−1 19.07	......	+1.67
Jan.18	10 57 5	12.5	5	−0 15.18	−0.01	−0 15.19	......	......	......	+0.436	......
	11 2 59	12.5	6	......	......	......	−0 3.24	0.00	−0 3.24	......	+3.54
	11 8 56	12.5	5	+0 4.96	0.00	+0 4.96	......	......	......	+0.448	......
	11 13 54	12.5	5	......	......	......	−0 14.66	0.00	−0 14.66	......	+3.68
	11 18 15	12.5	5	+0 21.87	+0.01	+0 21.88	......	......	......	+0.457	......
	11 23 38	12.5	5	......	......	......	−0 25.36	0.00	−0 25.36	......	+3.80
	11 29 18	12.5	5	+0 41.39	+0.03	+0 41.42	......	......	......	+0.466	......
	11 33 23	12.5	5	......	......	......	−0 36.26	+0.01	−0 36.25	......	+3.94
	11 41 16	12.5	5	+1 2.46	+0.04	+1 2.50	......	......	......	+0.476	......
	11 45 19	12.5	5	......	......	......	−0 49.22	+0.01	−0 49.21	......	+4.10
Jan.19	5 32 41	1	5	......	......	......	−1 42.82	−0.04	−1 42.86	......	+2.08
	5 37 51	1	5	+2 49.72	+0.04	+2 49.76	......	......	......	−0.171	......
	5 43 5	1	5	......	......	......	−1 53.51	−0.04	−1 53.55	......	+2.03
	5 47 26	2	5	......	......	......	−1 44.55	−0.03	−1 44.58	......	+2.01
	5 52 6	1	5	......	......	......	−2 3.05	−0.05	−2 3.10	......	+1.99
	5 56 12	2	5	−0 42.16	−0.01	−0 42.17	......	......	......	−0.131	......
	6 1 27	1	5	+3 30.86	+0.06	+3 30.92	......	......	......	−0.121	......
	6 7 33	2	5	......	......	......	−2 5.47	−0.04	−2 5.51	......	+1.93
	6 12 2	1	6	......	......	......	−2 23.62	−0.05	−2 23.67	......	+1.92
	6 37 0	2	5	......	......	......	−2 36.21	−0.05	−2 36.26	......	+1.87
	6 45 49	2	5	+0 43.97	+0.02	+0 43.99	......	......	......	−0.026	......
	6 50 23	2	5	......	......	......	−2 50.07	−0.05	−2 50.12	......	+1.86
	6 55 44	3	5	......	......	......	−0 8.13	0.00	−0 8.13	......	+1.86
	7 0 11	3	5	+1 40.57	+0.03	+1 40.60	......	......	......	+0.007	......
	7 4 44	3	5	......	......	......	−0 17.46	0.00	−0 17.46	......	+1.86
	8 29 29	12	5	......	......	......	−0 43.67	−0.02	−0 43.69	......	+2.12
	8 36 33	12	7	−1 6.30	−0.02	−1 6.32	......	......	......	+0.209	......
	8 42 6	12	5	......	......	......	−0 56.51	−0.02	−0 56.53	......	+2.20
	8 48 20	12	5	......	......	......	−1 3.59	−0.02	−1 3.61	......	+2.24
	8 52 54	12	5	−0 38.21	−0.01	−0 38.22	......	......	......	+0.240	......
	8 59 3	12	5	......	......	......	−1 14.85	−0.03	−1 14.88	......	+2.31
	9 8 50	12	5	......	......	......	−1 25.50	−0.03	−1 25.53	......	+2.39
	9 12 37	12	5	−0 3.63	0.00	−0 3.63	......	......	......	+0.279	......
	9 15 58	12	5	......	......	......	−1 33.54	−0.03	−1 33.57	......	+2.44
Jan.20	5 46 15	10	5	......	......	......	−2 40.86	−0.06	−2 40.91	......	+2.07
	5 52 21	10	5	+1 37.73	+0.03	+1 37.76	......	......	......	−0.137	......
	5 58 15	10	5	......	......	......	−2 53.38	−0.06	−2 53.44	......	+2.02
	6 15 7	10	5	......	......	......	−3 11.28	−0.06	−3 11.31	......	+1.97
	6 20 35	10	5	+2 26.69	+0.04	+2 26.73	......	......	......	−0.078	......
	6 25 42	10	5	......	......	......	−3 22.31	−0.06	−3 22.37	......	+1.95
	6 49 5	10	5	......	......	......	−3 46.81	−0.07	−3 46.88	......	+1.93
	6 55 56	10	5	+3 29.36	+0.06	+3 29.42	......	......	......	−0.002	......
	7 2 36	10	5	......	......	......	−4 1.16	−0.07	−4 1.23	......	+1.93
	10 37 59	1	5	......	......	......	+0 59.83	+0.02	+0 59.85	......	+3.32
	10 42 2	2	5	......	......	......	+2 9.02	+0.02	+2 9.04	......	+3.38
	10 46 56	1	5	−0 6.33	0.00	−0 6.33	......	......	......	+0.421	......
	10 51 14	2	5	−1 29.69	−0.05	−1 29.74	......	......	......	+0.430	......
	10 55 17	1	5	+0 9.03	+0.01	+0 9.04	......	......	......	+0.432	......
	11 0 51	2	4	−1 11.95	−0.04	−1 11.99	......	......	......	+0.437	......
	11 6 7	1	5	......	......	......	+0 28.92	+0.02	+0 28.94	......	+3.66
	11 9 52	2	5	......	......	......	+1 38.91	+0.02	+1 38.93	......	+3.70
	11 23 44	1	5	......	......	......	+0 9.79	+0.03	+0 9.82	......	+3.88
	11 28 32	2	5	......	......	......	+1 17.85	+0.03	+1 17.88	......	+3.95
	11 33 11	1	5	+1 17.81	+0.07	+1 17.88	......	......	......	+0.467	......
	11 37 30	2	5	−0 5.78	+0.03	−0 5.75	......	......	......	+0.470	......
	11 42 14	1	5	+1 33.58	+0.07	+1 33.65	......	......	......	+0.474	......
	11 47 10	2	5	+0 11.61	+0.02	+0 11.63	......	......	......	+0.477	......
	11 53 18	1	5	......	......	......	−0 22.56	+0.05	−0 22.51	......	+4.28
	11 58 17	2	6	......	......	......	+0 45.62	+0.04	+0 45.66	......	+4.34
Jan.21	10 27 58	9	5	−0 7.37	0.00	−0 7.37	......	......	......	+0.396	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900	90 Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Jan.21	10ʰ 33ᵐ 1ˢ	9	5	....	......	....	−3′ 6″.02	−0″.07	−3′ 6″.09	....	+3″.31
	10 38 29	9	5	+0′ 12″.19	0″.00	+0′ 12″.19	....	......	....	+0ˢ.410	......
	10 47 54	9	5	+0 29.61	+0.01	+0 29.62	....	......	....	+0.420	......
	10 53 43	9	5	....	......	....	−3 28.46	−0.07	−3 28.53	....	+3.56
	10 59 17	9	5	+0 50.25	+0.02	+0 50.27	....	......	....	+0.434	......
Jan.22	11 56 46	1	6	....	......	....	−2 6.73	−0.03	−2 6.76	....	+4.42
	12 3 22	1	5	+1 13.60	+0.03	+1 13.63	....	......	....	+0.481	......
	12 12 19	1	5	....	......	....	−2 23.89	−0.03	−2 23.92	....	+4.61
	12 18 9	2	5	....	......	....	+1 41.21	+0.01	+1 41.22	....	+4.69
	12 23 38	2	5	−1 3.70	−0.03	−1 3.73	....	......	....	+0.489	......
	12 28 3	2	5	....	......	....	+1 30.64	+0.01	+1 30.65	....	+4.81
Jan.24	6 2 50	1	5	+4 26.18	+0.08	+4 26.56	....	......	....	−0.110	......
	6 10 0	1	5	....	......	....	+3 10.27	+0.05	+3 10.32	....	+2.12
	6 17 15	1	5	+4 53.70	+0.08	+4 53.78	....	......	....	−0.081	......
	9 20 54	2	5	....	......	....	+1 52.51	+0.05	+1 52.56	....	+2.77
	9 26 50	2	5	+2 11.20	+0.05	+2 11.25	....	......	....	+0.304	......
	9 32 37	2	5	....	......	....	+1 40.98	+0.05	+1 41.03	....	+2.87
	9 39 56	2	5	....	......	....	+1 33.73	+0.05	+1 33.78	....	+2.93
	9 44 39	2	5	+2 45.92	+0.06	+2 45.98	....	......	....	+0.333	......
	9 49 24	2	5	....	......	....	+1 24.74	+0.06	+1 24.80	....	+3.01
Jan.25	5 43 32	1	5	....	......	....	−0 19.00	0.00	−0 19.00	....	+2.38
	5 47 32	1	4	−2 31.63	−0.05	−2 31.68	....	......	....	−0.143	......
	5 51 56	1	5	....	......	....	−0 27.67	0.00	−0 27.67	....	+2.35
	5 55 40	2	5	....	......	....	−1 7.13	−0.03	−1 7.16	....	+2.34
	5 59 35	3	5	....	......	....	−2 4.89	−0.05	−2 4.94	....	+2.32
	6 3 51	2	5	+3 17.99	+0.06	+3 18.05	....	......	....	−0.110	......
	6 7 15	3	5	+3 23.72	+0.06	+3 23.78	....	......	....	−0.106	......
	6 12 45	2	5	....	......	....	−1 24.90	−0.03	−1 24.93	....	+2.29
	6 15 46	3	5	....	......	....	−2 21.72	−0.05	−2 21.77	....	+2.28
	6 24 10	1	5	....	......	....	−1 0.86	−0.01	−1 0.87	....	+2.26
	6 28 29	1	3	+1 48.92	Not	*Eros.* An	11ᵐ star	......	....	....	......
	6 32 31	1	5	−1 7.21	−0.02	−1 7.23	....	......	....	−0.049	......
	6 36 35	1	5	−0 59.44	−0.02	−0 59.46	....	......	....	−0.041	......
	6 40 55	1	5	....	......	....	−1 17.92	+0.02	−1 17.90	....	+2.24
	6 47 54	4	5	....	......	....	+0 23.79	+0.01	+0 23.80	....	+2.23
	6 51 28	1	5	....	......	....	−1 28.96	+0.02	−1 28.94	....	+2.23
	6 57 8	4	5	+0 49.51	+0.01	+0 49.52	....	......	....	+0.002	......
	7 0 40	1	5	−0 14.34	0.00	−0 14.34	....	......	....	+0.010	......
	7 4 41	1	5	−0 6.65	0.00	−0 6.65	....	......	....	+0.019	......
	7 9 18	4	3	....	......	....	+0 2.14	0.00	+0 2.14	....	+2.24
	7 12 2	4	2	....	......	....	−0 1.40	0.00	−0 1.40	....	+2.24
	7 15 43	1	5	....	......	....	−1 54.11	−0.03	−1 54.14	....	+2.24
	7 41 39	1	5	....	......	....	−2 21.20	−0.04	−2 21.24	....	+2.29
	7 48 55	1	5	+1 16.45	+0.02	+1 16.47	....	......	....	+0.112	......
	7 53 50	1	5	+1 25.32	+0.03	+1 25.35	....	......	....	+0.123	......
	7 58 36	1	5	....	......	....	−2 38.63	−0.05	−2 38.68	....	+2.35
Jan.27	6 45 53	13	5	+3 6.27	+0.05	+3 6.32	....	......	....	−0.017	......
	6 52 30	13	5	....	......	....	+0 40.92	+0.01	+0 40.93	....	+2.35
	6 57 36	13	5	+3 29.28	+0.06	+3 29.34	....	......	....	+0.008	......
Jan.28	6 57 18	13	5	+1 11.52	+0.02	+1 11.51	....	......	....	+0.006	......
	7 2 16	13	5	....	......	....	+1 55.18	+0.04	+1 55.22	....	+2.42
	7 6 56	13	5	+1 30.39	+0.02	+1 30.41	....	......	....	+0.027	......
Feb.1	5 52 19	10	5	−2 43.14	−0.05	−2 43.19	....	......	....	−0.239	......
	5 58 36	10	5	....	......	....	+1 39.76	+0.04	+1 39.80	....	+2.72
	6 5 0	10	5	−2 18.24	−0.04	−2 18.28	....	......	....	−0.215	......
	6 24 11	10	5	−1 39.76	−0.03	−1 39.79	....	......	....	−0.179	......
	6 29 32	10	5	....	......	....	+1 8.93	+0.02	+1 8.95	....	+2.66
	6 31 37	10	5	−1 18.61	−0.02	−1 18.63	....	......	....	−0.159	......
	6 50 39	10	5	−0 46.60	−0.01	−0 46.61	....	......	....	−0.128	......
	6 55 39	10	5	....	......	....	+0 42.48	+0.01	+0 42.49	....	+2.65
	6 59 38	10	5	−0 28.82	−0.01	−0 28.83	....	......	....	+0.138	......
	7 5 15	10	6	−0 17.31	−0.01	−0 17.35	....	......	....	+0.150	......
	7 11 49	10	5	....	......	....	+0 26.03	+0.01	+0 26.04	....	+2.66
	7 16 6	10	5	+0 4.31	0.00	+0 4.34	....	......	....	+0.171	......

MICROMETRICAL OBSERVATIONS OF *EROS*—*Continued*

Date—1900 90° Time	Comp. Star	No. Obs.	Measured Δα	Ref.	Corrected Δα	Measured Δδ	Ref.	Corrected Δδ	Parallax Factors Δα	Parallax Factors Δδ
Feb. 4 9h 33m 5s	10.5	5	....	......	....	+1′ 24″.70	0″.00	+1′ 24″.70	....	+3″.46
9 39 8	10.5	5	−2′ 20″.64	−0″.06	−2′ 20″.70	....	......	....	+0s.316	......
9 45 30	10.5	6	....	......	....	+1 11.44	0.00	+1 11.44	....	+3.55
10 21 36	10.5	5	....	......	....	+0 34.43	0.00	+0 34.43	....	+3.85
10 26 3	10.5	5	−0 43.43	−0.02	−0 43.45	....	......	....	+0.380	......
10 30 36	10.5	5	....	......	....	+0 25.37	0.00	+0 25.37	....	+3.94
10 40 44	10.5	5	....	......	....	+0 15.00	0.00	+0 15.00	....	+4.03
10 44 57	10.5	4	−0 3.62	0.00	−0 3.62	....	......	....	+0.402	......
10 46 53	10.5	est.	0 0.00	0.00	0 0.00	....	......	....	+0.404	......
10 48 19	10.5	2	+0 2.63	0.00	+0 2.63	....	......	....	+0.405	......
10 52 46	10.5	7	....	......	....	+0 2.63	0.00	+0 2.63	....	+4.17
Feb. 5 6 5 27	1	5	+1 7.41	+0.02	+1 7.43	....	......	....	−0.096	......
6 9 47	2	5	−2 16.64	−0.04	−2 16.68	....	......	....	−0.088	......
6 16 25	1	5	....	......	....	+0 20.19	0.00	+0 20.19	....	+2.93
6 19 52	2	2	....	......	....	+0 1.50	0.00	+0 1.50	....	+2.92
6 23 27	2	3	....	......	....	−0 2.46	0.00	−0 2.46	....	+2.91
6 29 7	1	5	+1 55.93	+0.03	+1 55.96	....	......	....	−0.047	......
6 33 28	2	5	−1 28.09	−0.03	−1 28.12	....	......	....	−0.039	......
6 45 18	2	6	−1 3.70	−0.02	−1 3.72	....	......	....	−0.015	......
6 51 57	2	6	....	......	....	−0 30.40	−0.01	−0 30.41	....	+2.89
6 56 47	2	5	−0 39.73	−0.01	−0 39.74	....	......	....	+0.008	......
7 5 34	2	5	−0 22.22	−0.01	−0 22.23	....	......	....	+0.027	......
7 10 45	2	5	....	......	....	−0 49.18	−0.01	−0 49.19	....	+2.90
7 15 10	2	5	−0 2.43	0.00	−0 2.43	....	......	....	+0.047	......
7 17 16	2	2	+0 2.24	0.00	+0 2.24	....	......	....	+0.051	......
10 7 29	10	5	−1 43.36	0.05	−1 43.41	....	......	....	+0.355	......
10 13 38	10	5	....	......	....	−0 13.83	−0.03	−0 13.86	....	+3.82
10 20 6	10	5	−1 17.10	−0.04	−1 17.14	....	......	....	+0.372	......
10 29 51	10	5	−0 56.84	−0.03	−0 56.87	....	......	....	+0.383	......
10 34 41	10	5	....	......	....	−0 34.83	−0.03	−0 34.86	....	+4.01
10 39 56	10	5	−0 35.80	−0.02	−0 35.82	....	......	....	+0.396	......
10 47 43	10	5	−0 19.53	−0.02	−0 19.55	....	......	....	+0.403	......
10 52 46	10	5	....	......		−0 53.43	−0.03	−0 53.46	....	+4.17
10 56 0	10	1	−0 1.63	−0.01	−0 1.64	....	......	....	+0.412	......
10 58 39	10	4	+0 3.26	−0.01	+0 3.25	....	......	....	+0.414	......

COMPARISON STARS

The following table contains the comparison stars used in these measures. The accurate positions of these stars are now being photographically measured in Europe and are not yet available.

Date	Star	Mag.	Time	Remarks
Oct. 2	1	10.5	8h 12m to 8h 38m	
	2	11.0	8 12 to 8 38	
	8.6	8.6	8 50 to 9 03 and 11 32 to 11 52	Same star both times
	Eros	10.5	....	
	12	12	16 46 to 17 4	
Oct. 3	1	10	12 50 to 13 18	
	2	10.8	12 50 to 13 18	
Oct. 4	10.3	10.3	11 59 to 12 13	
	Eros	10	....	
Oct. 8	1	12	7 27 to 8 11	
	2	12	7 27 to 8 11	
	....	9.5	8 32 and 12 36 to 13 10	1855.0 α 2h 40m 15.0s = +47° 25′.0
	1	13	16 42 to 17 5	
	2	12.5	16 42 to 17 5	
	9.8	9.8	17 9 to 17 36	
Oct. 9	1	12.2	7 15 to 8 47	
	2	12	7 15 to 8 47	
	3	12.5	7 15 to 8 47	
	Eros	10	....	
	....	9	14 11 to 14 32	
	1	9.8	16 19 to 17 41	
	2	10	16 19 to 17 41	
Oct. 10	....	12.7	12 50 to 13 2	
Oct. 11	1	12.5	6 44 to 8 4	

COMPARISON STARS—*Continued*

Date	Star	Magnitude	Time	Remarks
Oct. 11	2	12.5	6h 14m to 8h 4m	
	1	12	13 47 to 14 7	
	2	12.5	13 47 to 14 7	
	1	12.5	16 32 to 17 31	
	2	12	16 32 to 17 31	
Oct. 14	1	12.5	7 17 to 7 34	
	2	10	7 17 to 7 31	
	1	....	16 57 to 17 45	
	2	....	16 57 to 17 45	
Oct. 15	1	10	6 41 to 7 22	
	2	10.5	6 41 to 7 22	
Oct. 16	1	12	6 38 to 7 33	
	2	12.5	6 38 to 7 33	
	3	12	6 38 to 7 33	
	7.8	7.8	12 30 to 12 56	Same star
	1	7.8	16 40 to 17 50	
	2	10	16 40 to 17 50	
Oct. 17	...	10.5	7 9 to 7 30	
	...	10	11 11 to 11 57	
	1	A little fainter than *Eros*	16 56 to 17 46	
	2	....	16 56 to 17 46	
Oct. 18	...	9.2	16 3 to 16 17	
Oct. 25	1	12	6 18 to 7 52	
	2	10.5	6 18 to 7 52	
	1	10.5	11 31 to 11 43	Same star
	1	10.5	16 31 to 17 51	
	2	10.5	16 31 to 17 51	
Oct. 26	1	12	5 55 to 9 3	Same as * 1 at 11h 56m to 12h 11m
	2	12.5	6 14 to 6 27	
	1	12	11 56 to 12 11	Same as * 1 at 5h 55m to 9h 3m
	1	11	16 25 to 17 36	
	2	11	16 25 to 17 36	
	3	11	16 25 to 17 36	
Oct. 27	1	12	9 7 to 9 30	
	2	13	9 34 to 9 47	
Oct. 30	...	11	15 52 to 16 12	
Nov. 1	1	10	5 55 to 6 56	
	2	11	5 55 to 6 56	
	3	10.5	5 55 to 6 56	
	4	9.2	5 55 to 6 56	
	1	....	8 10 to 9 0	
	2	....	8 10 to 9 0	
	3	....	8 10 to 9 0	
	1	9.8	16 46 to 18 1	
	2	10	16 46 to 18 1	
	3	10	16 46 to 18 1	
Nov. 2	1	10.5	5 42 to 6 39	Same as * 1 8h 9m to 8h 44m
	2	12.5	5 42 to 6 39	
	3	10	5 42 to 6 39	Same as * 3 8 9 to 8 44
	1	10.5	8 9 to 8 44	Same as * 1 5 42 to 6 39
	3	10	8 9 to 8 41	Same as * 3 5 42 to 6 39
	4	....	8 9 to 8 44	
	1	10.2	12 17 to 12 58	Same as * 1 16 56 to 18 8
	2	9.9	12 17 to 12 58	Same as * 2 16 56 to 18 8
	1	10.2	16 56 to 18 8	Same as * 1 12 17 to 12 58
	2	9.9	16 56 to 18 8	Same as * 2 12 17 to 12 58
	3	11	16 56 to 18 8	
Nov. 3	1	11	5 39 to 8 32	
	2	9.5	5 39 to 8 32	
	10	10	10 52 to 11 10	
	9.5	9.5	11 18 to 11 31	
	1	10.5	16 18 to 18 6	
	2	10.5	16 18 to 18 6	
	3	12	16 18 to 18 6	
Nov. 4	1	11.5	6 2 to 8 30	
	2	11	6 2 to 8 30	
	3	10	6 2 to 8 30	Same as * 3 10 26 to 10 40
	4	11	6 2 to 8 30	Same as * 4 10 26 to 10 40
	4	11	10 26 to 10 35	
	3	10	10 30 to 10 40	
	1	10	16 21 to 18 11	

COMPARISON STARS—*Continued*

Date	Star	Magnitude	Time	Remarks
Nov. 4	2	10	16^h 21^m to 18^h 11^m	
Nov. 5	1	13	5 37 to 7 51	
	2	13.5	5 37 to 7 51	
	3	12	5 37 to 7 51	
	4	....	5 37 to 7 51	
	5	14	5 37 to 7 51	
	6	12	5 37 to 7 51	Same as * 6 10 33 to 10 50
	7	10	5 37 to 7 51	
	6	12	10 33 to 10 50	Same as * 6 5 37 to 7 51
Nov. 6	...	12	10 23 to 10 28	
Nov. 7	1	11.5	13 8 to 13 16	
	2	11	13 8 to 13 16	
Nov. 8	1	11.5	5 50 to 8 18	
	2	11.5	5 50 to 8 18	
	3	11.5	5 50 to 8 18	
	1	11	16 16 to 17 52	
	2	11.5	16 16 to 17 52	
Nov. 10	1	Same as *Eros*	5 44 to 7 16	
	1	...	14 51 to 15 37	
	2	...	14 51 to 15 37	
	1	12	16 41 to 17 3	
	2	12	16 41 to 17 3	
	3	12	16 41 to 17 3	
Nov. 11	...	$\frac{2}{10}$m less than *Eros*	6 28 to 6 49	
	...	9.7 $\frac{3}{10}$m less than *Eros*	7 9 to 8 5	
Nov. 13	1	11	5 48 to 8 3	
	2	11	5 48 to 8 3	
	1	11	8 49 to 9 28	A new set of stars
	2	11	8 49 to 9 28	Same as * 2 11 24 to 11 59
	1	...	11 24 to 11 59	
	2	11	11 24 to 11 59	Same as * 2 8 49 to 9 28
	2	11	16 56 to 18 16	
	3	10	16 56 to 18 16	
Nov. 15	1	11.5	6 13 to 7 55	
	2	11	6 13 to 7 55	
Nov. 21	1	11	5 33 to 6 29	Same as * 1 below
	2	11	5 33 to 6 29	Same as * 2 below
	3	11	5 33 to 6 29	Same as * 3 below
	4	10	5 33 to 6 29	
	1	11	7 11 to 8 25	Same as * 1 5 33 to 6 29
	2	11	7 11 to 8 25	Same as * 2 5 33 to 6 29
	3	10	7 11 to 8 25	Same as * 3 5 33 to 6 29
	1	9.5	16 46 to 17 33	
Nov. 22	1	9.0	7 25 to 8 51	
	2	9.5	7 25 to 8 51	
	1	10	15 52 to 17 26	
	2	11	15 52 to 17 26	
Nov. 23	...	.5m fainter than *Eros*	9 45 to 10 2	
Nov. 25	1	9.7	6 33 to 9 12	
	2	9.0	6 33 to 9 12	Same star
	2	9.0	15 18 to 17 58	
	3	n. p. of two 10m stars	15 18 to 17 58	
	4	10 s. f. of the two	15 18 to 17 58	
Nov. 26	1	..	5 35 to 8 15	Same as * 1 12 14 to 12 59
	3	10	5 35 to 8 15	Same as * 3 Nov. 25
	4	10	5 35 to 8 15	Same as * 4 Nov. 25
	1	..	12 14 to 12 59	Same as * 1 5 35 to 8 15
	2	..	12 14 to 12 59	Same star
	2	..	15 15 to 16 58	
	5	11	15 15 to 16 58	
	6	11	15 15 to 16 58	
Nov. 27	7.7	7.7	5 21 to 8 13	
	1	11	5 21 to 8 13	
	2	11	5 21 to 8 13	
Nov. 29	1	9.5	5 31 to 8 31	
	2	9.8	5 31 to 8 31	
	3	11	5 31 to 8 31	
	...	11	15 42 to 16 44	
Dec. 1	1	11	15 30 to 16 26	
	2	10	15 30 to 16 26	
Dec. 2	1	12	5 42 to 6 16	

COMPARISON STARS—*Continued*

Date	Star	Magnitude	Time	Remarks
Dec. 2	2	11	5^h 42^m to 6^h 16^m	
	3	11	5 42 to 6 16	
Dec. 5	1	9.7	6 49 to 9 29	
	2	9.2	6 49 to 9 29	
	3	10m (11m star close n. p.)	6 49 to 9 29	
	1	.5m fainter than *Eros*	13 53 to 15 7	
	11	11m (s. of two 11m stars)	13 53 to 15 7	
Dec. 8	...	9.8	6 23 to 8 22	
	...	Nearly 1m fainter than *Eros*	12 53 to 14 58	
	11	11	13 50 to 14 12	
Dec. 9	1	11	5 19 to 8 12	
	2	11	5 19 to 8 12	
	3	11.5	5 19 to 8 12	
	...	11.5	14 58 to 15 51	
Dec. 10	1	10	5 21 to 7 52	
	2	10	5 21 to 7 52	
Dec. 11	...	10.5	5 2 to 7 26	
	1	11	13 51 to 15 37	
	2	9(?)	13 51 to 15 37	
Dec. 12	1	8.5	4 58 to 8 9	
	2	10m (1m fainter than *Eros*)	4 58 to 8 9	
	3	12	4 58 to 8 9	
Dec. 17	1	9	8 57 to 9 9	
	2	9.2	8 57 to 9 9	
Dec. 18	1	11	4 55 to 7 41	
	2	8.8	4 55 to 7 41	
	3	12	4 55 to 7 41	
	9	9	12 46 to 15 2	
	12	12	14 20 to 14 33	
Dec. 19	1	11	5 6 to 7 37	
	2	11	5 6 to 7 37	
	3	11	5 6 to 7 37	
	1	11	12 47 to 14 29	
	2	11	12 47 to 14 29	
	3	11	12 47 to 14 29	
	4	11	12 47 to 14 29	
Dec. 20	...	...	6 4 to 7 35	
Dec. 21	1	12.5	13 47 to 14 16	
	2	12.5	13 47 to 14 16	
Dec. 24	1	11	13 27 to 14 5	
	2	10.5	13 27 to 14 5	
Dec. 26	13	13	5 57 to 6 46	
Dec. 28	1	11.5	5 20 to 7 12	
	2	12.5	5 20 to 7 12	
	8	8	11 14 to 12 33	
	13	13	11 14 to 12 33	
Dec. 29	9.5	9.5	5 26 to 7 19	
	1	13	5 56 to 6 21	
	2	13	5 56 to 6 21	
Dec. 30	1	10.5±	5 29 to 6 43	
	2	12±	5 29 to 6 43	
Dec. 31	9.5	9.5	5 45 to 10 49	
	12.5	12.5	12 43 to 12 57	
Jan. 1	1	12.5	5 42 to 7 7	
	2	11.5	5 42 to 7 7	
	1	9.5	10 58 to 11 24	
	2	11.5	10 58 to 11 24	
	10	10	12 43 to 13 57	
Jan. 2	10.5	10.5	5 17 to 7 2	
	10	10	12 42 to 13 15	
Jan. 3	1	13	5 39 to 6 43	
	2	13	5 39 to 6 43	
	1	10	10 36 to 13 26	
	2	11	10 36 to 13 26	
	3	10	10 36 to 13 26	
	4	10	10 36 to 13 26	
Jan. 8	1	11	5 55 to 8 22	
	2	11	5 55 to 8 22	
	3	11	5 55 to 8 22	
Jan. 12	11	11	6 5 to 6 15	
Jan. 14	1	10	5 58 to 7 2	

COMPARISON STARS—*Continued*

Date	Star	Magnitude	Time	Remarks
Jan. 14	2	12	5^h 58^m to 7^h 2^m	
	11.5	11.5	8 43 to 9 58	
	9	9	10 25 to 12 36	
Jan. 16	12	12	5 43 to 7 16	
Jan. 18	12.5	12.5	10 57 to 11 45	
Jan. 19	1	10	5 32 to 7 4	
	2	13	5 32 to 7 4	
	3	13	5 32 to 7 4	
	12	12	8 29 to 9 15	
Jan. 20	10	10	5 46 to 7 2	
	1	9.8	10 37 to 11 58	
	2	10	10 37 to 11 58	
Jan. 21	9	9	10 27 to 10 59	
Jan. 22	1	11	11 56 to 12 28	
	2	12	11 56 to 12 28	
Jan. 24	1	1m br. than *Eros*. A 12m star fol. it 1.5	6 2 to 6 17	
	2	.5m fainter than *Eros*	9 20 to 9 49	
Jan. 25	1	9.8	5 43 to 7 58	
	2	11	5 43 to 7 58	
	3	10.5	5 43 to 7 58	
	4	12	5 43 to 7 58	
Jan. 27	...	13	6 45 to 6 57	
Jan. 28	...	13	6 57 to 7 6	
Feb. 1	...	10	5 52 to 7 16	
Feb. 4	...	10.5	9 33 to 10 52	
Feb. 5	1	9.5	6 5 to 7 17	
	2	8	6 5 to 7 17	
	...	10	10 7 to 10 58	

BAROMETER AND THERMOMETERS

A copy of the barometer and temperature records follows. These are from the regular records of the observatory.

Date 1900	Barometer			Attached Thermometer (F.)			External Thermometer (F.)		
	9 P. M.	1 A. M.	4 A. M.	9 P. M.	1 A. M.	4 A. M.	9 P. M.	1 A. M.	4 A. M.
Oct. 2.......	29.01	29.20	29.15	71	73	73	63	65	67
Oct. 3.......	29.02	29.03	.....	77	77	..	73	68	..
Oct. 4.......	28.90	29.00	29.02	75	76	77	66	68	67
Oct. 8.......	29.25	29.28	29.27	72	72	73	47	45	43
Oct. 9.......	29.30	29.30	29.28	72	71	71	52	48	46
Oct. 10.......	29.19	29.10	29.08	71	71	71	53	51	49
Oct. 11.......	29.00	28.95	29.08	73	73	72	53	52	52
Oct. 14.......	29.10	29.10	29.05	73	73	73	61	57	56
Oct. 15.......	28.93	29.10	.....	74	74	..	63	59	..
Oct. 16.......	29.42	29.35	29.35	71	72	71	39	39	38
Oct. 17.......	29.10	29.15	29.15	70	71	72	47	41	42
Oct. 18.......	29.10	29.18	29.17	70	75	75	49	47	47
Oct. 25.......	29.05	29.12	29.20	78	78	76	64	61	58
Oct. 26.......	29.22	29.20	29.20	78	78	79	57	53	52
Oct. 27.......	29.10	29.05	.....	75	78	..	57	58	..
Oct. 30.......	28.92	28.90	28.80	76	73	73	59	58	59
Nov. 1.......	29.15	29.15	29.20	79	78	79	41	39	39
Nov. 2.......	29.30	29.35	29.22	78	76	78	50	45	43
Nov. 3.......	29.00	28.97	28.95	79	81	83	49	49	47
Nov. 4.......	28.98	29.00	29.05	80	78	77	52	39	34
Nov. 5.......	29.10	29.10	29.15	78	78	76	42	36	35
Nov. 6.......	28.90	28.90	.....	69	76	..	30	28	..
Nov. 7.......	28.88	28.90	.....	68	71	..	29	25	..
Nov. 8.......	28.80	28.80	28.80	76	76	76	27	24	22
Nov. 10.......	29.18	29.00	29.10	75	65	75	30	31	28
Nov. 11.......	29.10	29.00	.....	73	73	..	27	29	..
Nov. 13.......	28.90	28.95	29.00	76	77	77	19	14½	12
Nov. 15.......	29.40	29.50	29.50	78	78	78	14	12	14
Nov. 21.......	28.95	28.80	.....	75	78	..	28	30	..
Nov. 22.......	29.00	29.15	29.20	78	80	80	29	25	22

BAROMETER AND THERMOMETERS—*Continued*

Date 1900	Barometer			Attached Thermometer (F.)			External Thermometer (F.)		
	9 P. M.	1 A. M.	4 A. M.	9 P. M.	1 A. M.	4 A. M.	9 P. M.	1 A. M.	4 A. M.
Nov. 23......	29.25	29.20	29.20	80	80	80	29	30	31
Nov. 25......	29.08	29.05	29.00	72	75	75	28	25	24
Nov. 26......	29.00	28.90	28.88	78	78	78	28	28	28
Nov. 27......	28.90	29.00	.....	80	80	..	31	28	..
Nov. 29......	29.05	29.00	29.00	70	72	72	27	28	29
Dec. 1......	29.10	29.00	29.00	65	64	68	30	32	29
Dec. 2......	29.05	29.00	.....	68	62	..	32	33	..
Dec. 5......	29.18	29.15	.....	78	78	..	28	25	..
Dec. 8......	28.90	29.00	.....	75	78	..	32	23	..
Dec. 9......	29.40	29.35	29.30	70	73	75	9	6	7
Dec. 10......	29.20	29.10	.....	74	74	..	16	17	..
Dec. 11......	29.18	29.10	29.00	77	78	78	12	11	12
Dec. 12......	28.78	28.70	.....	80	80	..	31	27	..
Dec. 17......	29.00	28.95	28.80	68	69	70	31	35	38
Dec. 18......	29.05	29.10	29.18	75	75	78	31	32	30
Dec. 19......	29.10	29.10	29.10	80	80	81	32	28	26
Dec. 20......	28.90	28.80	28.90	82	80	75	33	32	31
Dec. 21......	28.45	28.45	28.15	72	72	72	38	40	40
Dec. 24......	28.90	28.90	28.90	66	65	62	14	12	16
Dec. 26......	29.00	29.00	.....	70	73	..	19	18	..
Dec. 28......	29.15	29.05	29.00	75	75	75	13	11	13
Dec. 29......	28.78	28.70	.....	75	78	..	22	21	..
Dec. 30......	28.75	28.68	28.65	75	69	60	28	20	18
Dec. 31......	29.20	29.30	29.32	75	75	76	−5	−10	−11
Jan. 1, 1901.	29.40	29.40	.....	68	70	..	9	4	..
Jan. 2......	29.50	29.50	29.18	76	75	75	0	2	8
Jan. 3......	29.20	29.20	.....	73	75	..	22	19	..
Jan. 8......	29.05	29.10	.....	73	66	..	22	14	..
Jan. 12......	29.00	28.90	.....	72	78	..	22	28	..
Jan. 14......	28.88	28.65	28.65	72	75	75	30	30	29
Jan. 16......	28.72	.....	.....	73	..	..	17	..	..
Jan. 18......	29.08	.....	.....	75	..	..	12	..	..
Jan. 19......	29.20	29.00	.....	72	70	..	22	29	..
Jan. 20......	28.80	28.78	28.70	70	72	75	42	39	39
Jan. 21......	29.20	29.22	.....	75	78	..	28	25	..
Jan. 22......	29.10	28.95	28.90	78	78	78	27	27	28
Jan. 24......	28.98	29.00	.....	75	75	..	10	12	..
Jan. 25......	29.05	29.00	29.00	77	79	80	18	20	28
Jan. 27......	28.60	.....	.....	65	..	..	16	..	..
Jan. 28......	28.75	.....	.....	72	..	..	8	..	..
Feb. 1......	28.90	.....	.....	71	..	..	4	..	..
Feb. 4......	29.35	.....	.....	70	..	..	7	..	..
Feb. 5......	29.35	29.25	.....	72	70	..	0	−5	..

EARLIER MICROMETRICAL OBSERVATIONS OF *EROS*, 1898-99

Previous to the preceding observations of *Eros*, the planet was measured with the large telescope on twenty-seven nights in 1898 and on thirteen nights in 1900. These observations have not been printed and are here published for the first time.

Date—1898-99 90 Time	Comp. Star	No. Comp.	Planet-Star $\Delta\alpha$	Planet-Star $\Delta\delta$	Apparent α	Apparent δ	Parallax Factors α	Parallax Factors δ	Red. to Apparent α	Red. to Apparent δ
Sept.10 12h 1m 22s	1	6	....	−0′ 18″.5	....	−6° 20′ 26″.9	....	+6″.43	....	+18″.2
12 7 19	1	6	+0m 10s.25	....	20h 44m 26s.16	....	+0s.294	......	+4s.33	......
Sept.11 8 18 40	2	4	....	−2 10.4	....	−6 20 38.0	....	+6.58	......	+18.1
8 22 47	2	6	+0 15.62	......	20 43 38.55	....	−0.094	......	+4.32	......
8 26 11	2	3	....	−2 10.3	....	−6 20 37.9	....	+6.59	......	+18.1
Sept.12 7 43 41	3	4	−0 4.30	....	20 42 45.89	....	−0.158	......	+4.31	......
7 49 4	3	4	......	+2 43.9	....	−6 20 50.2	....	+6.56	......	+18.1
7 53 39	3	1	−0 4.71	....	20 42 45.48	....	−0.140	......	+4.31	......
Sept.19 9 22 51	4	3	....	−2 25.4	....	−6 21 23.9	....	+6.51	......	+17.7
9 31 46	4	1	−0 39.75	....	20 37 53.52	....	+0.105	......	+4.20	......
9 43 59	4	2	....	−2 26.0	....	−6 21 24.5	....	+6.57	......	+17.7
9 49 20	4	2	−0 40.22	....	20 37 53.05	....	+0.137	......	+4.20	......
Sept.20 8 18 23	4	1	....	−2 19.9	....	−6 21 18.3	....	+6.60	......	+17.8

EARLIER MICROMETRICAL OBSERVATIONS OF *EROS*, 1898-99—*Continued*

Date—1898-99	90° Time	Comp. Star	No. Comp.	Planet-Star Δα	Planet-Star Δδ	Apparent α	Apparent δ	Parallax Factors α	Parallax Factors δ	Red. to Apparent α	Red. to Apparent δ
Sept.20	8h 28m 43s	4	4	−1m 6s.43		20h 37m 26s.83		−0s.006		+4s.19	
	8 50 24	4	3	−1 6.86		20 37 26.40		+0.036		+4.19	
Sept.21	8 52 1	5	4		+0′ 11″.8		−6° 21′ 9″.2		+6″.62		+17″.7
	9 1 40	5	4	+0 57.49		20 37 1.23		+0.046		+4.18	
Sept.23	7 21 3	5	3		+0 41.9		−6 20 39.1		+6.58		+17.7
	7 29 3	5	4	+0 18.52		20 36 22.25		−0.091		+4.17	
	7 33 37	5	3		+0 42.1		−6 20 38.9		+6.59		+17.7
	7 39 39	5	3	+0 18.36		20 36 22.09		−0.076		+4.17	
Sept.24	7 39 48	5	4		+1 3.1		−6 20 17.9		+6.59		+17.7
	7 43 37	5	5	+0 2.78		20 36 7.50		−0.057		+4.16	
	7 46 53	5	3		+1 3.0		−6 20 18.0		+6.59		+17.7
Sept.25	7 19 33	5	4		+1 28.4		−6 19 52.6		+6.58		+17.7
	7 24 19	5	6	−0 9.46		20 35 54.25		−0.090		+4.15	
	7 27 47	5	3		+1 28.4		−6 19 52.6		+6.59		+17.7
Sept.26	7 22 21	5	4		+1 57.8		−6 19 23.3		+6.59		+17.6
	7 33 17	5	6	−0 18.86		20 35 44.84		−0.063		+4.14	
	7 43 50	5	3		+1 58.4		−6 19 22.7		+6.60		+17.6
	7 50 34	5	2	−0 19.00		20 35 44.70		−0.029		+4.14	
Sept.27	6 58 31	5	4		+2 31.2		−6 18 49.9		+6.58		+17.6
	7 8 9	5	5	−0 25.10		20 35 38.58		−0.102		+4.12	
Oct. 10	9 29 15	6	4		−0 21.4		−6 3 31.3		+6.48		+17.8
	9 34 46	6	5	−0 0.86		20 38 37.97		+0.251		+3.94	
	9 42 12	6	3		−0 21.9		−6 3 31.8		+6.46		+17.8
	9 48 13	6	3	−0 0.61		20 38 38.22		+0.272		+3.94	
Oct. 11	7 17 2	6	5	+0 28.62		20 39 7.43		+0.013		+3.92	
	7 24 53	6	5		+1 18.1		−6 1 51.8		+6.57		+17.8
	7 30 52	6	4	+0 28.90		20 39 7.71		+0.039		+3.92	
Nov. 26	6 30 40	7	4	−0 2.21		21 37 46.86		+0.155		+3.50	
	6 36 6	7	5		−2 1.1		−2 22 4.9		+6.12		+21.7
	6 40 31	7	4	−0 1.46		21 37 47.61		+0.173		+3.50	
Nov. 27	8 13 56	8	5	+0 7.93		21 39 48		+0.231		+3.50	
	8 19 15	8	1		+0 40.7		−2 13.5		+6.16		+21.8
Dec. 3	6 7 32	9	4	−0 7.52		21 50 54.26		+0.120		+3.50	
	6 12 45	9	4		+4 21.1		−1 23 43.2		+6.07		+22.5
Dec. 6	6 46 58	10	5	+0 15.74		21 56 50.78		+0.219		+3.47	
	6 54 22	10	5		−3 11.1		−0 56 17.5		+6.02		+22.8
Dec. 10	6 0 41	11	5	−0 14.29		22 4 50.3		+0.151		+3.46	
	6 6 56	11	5		+2 51.2		−0 18.8		+5.92		+22.1
	6 13 28	11	4	−0 13.25				+0.172		+3.46	
Dec. 13	7 9 3	12	4		−0 36.0				+5.91		+23.6
	7 13 18	12	4	+0 6.21				+0.279		+3.47	
	7 17 32	12	3		−0 32.3				+5.91		+23.6
Dec. 17	6 10 49	13	3	+0 5.31		22 19 31.16		+0.192		+3.48	
	6 13 54	13	3		−0 34.4		+0 53 10.9		+5.83		+24.0
Jan. 18	7 22 50	14	4		+3 19.1		+7 31 35.7		+5.41		+6.4
	7 29 24	14	5	+0 5.51		23 35 30.62		+0.371		+0.51	
	7 34 52	14	4		+3 26.1		+7 31 32.7		+5.44		+6.4
Jan. 24	6 52 31	15	4	+0 10.05		23 51 12.72		+0.340		+0.55	
	6 59 3	15	5		−2 59.6		+8 55 35.8		+5.24		+6.6
	7 5 9	15	3	+0 11.42		23 51 14.12		+0.355		+0.55	
Jan. 31	6 43 7	16	4	−0 15.07				+0.342		+0.57	
	6 50 16	16	6		+0 9.4				+5.10		+6.6
	6 57 23	16	5	−0 13.45				+0.358		+0.57	
Feb. 1	6 43 23	17	4	+0 0.51		0 13 0.77		+0.343		+0.57	
	6 48 40	17	4		+2 1.7		+10 50 17.3		+5.10		+6.6
	6 56 22	17	4		+2 06.4		+10 50 21.9		+5.10		+6.6
Feb. 7	6 54 44	18	4		−4 28.8				+5.04	+0.61	
	7 14 20	18	4	−0 36.57				+0.385			+5.7
Feb. 12	6 52 42	19	4	−0 5.09		0 44 37.42		+0.369		+0.64	
	6 58 27	19	5		−1 20.3		+13 29 55.5		+4.95		+6.9
	7 4 11	19	4	−0 3.66		0 44 38.85		+0.382		+0.64	

DIRECT MEASURES OF Δα

As many of the differences of right ascension were measured direct with the micrometer and afterwards reduced to time, it is thought best to tabulate the original measures themselves, and they are given below.

MEASURED DIFFERENCES OF RIGHT ASCENSION

Date 1898	90th Meridian Time	Δα in Arc Planet-Star	Date 1898	90th Meridian Time	Δα in Arc Planet-Star	Date 1898-99	90th Meridian Time	Δα in Arc Planet-Star
Sept. 10......	12h 7m 19s	+152″.8	Sept. 26......	7h 33m 17s	−281″.1	Dec. 10......	6h 13m 28s	−198″.7
Sept. 11......	8 22 47	+225.7	Sept. 26......	7 50 34	−283.2	Dec. 13......	7 13 18	+ 93.2
Sept. 12......	7 43 41	− 64.1	Sept. 27......	7 8 9	−374.1	Dec. 17......	6 10 49	+ 79.7
Sept. 12......	7 53 39	− 70.2	Oct. 10......	9 34 46	− 12.9	Jan. 18......	7 29 24	+ 82.8
Sept. 19......	9 31 46	−592.6	Oct. 10......	9 48 13	− 9.1	Jan. 24......	6 52 31	+148.7
Sept. 19	9 49 20	−599.4	Oct. 11......	7 17 2	+186.6	Jan. 24......	7 5 9	+169.1
Sept. 20......	8 28 43	−990.4	Oct. 11......	7 30 52	+190.9	Jan. 31......	6 43 7	−222.1
Sept 20......	8 50 24	−997.1	Nov. 26......	6 30 40	− 33.1	Jan. 31......	6 57 23	−198.3
Sept. 21......	9 1 40	+857.2	Nov. 26......	6 40 31	− 21.9	Feb. 1......	6 43 23	+ 7.5
Sept. 23......	7 29 3	+276.1	Nov. 27......	8 13 56	+118.9	Feb. 7......	7 14 20	−536.5
Sept. 23......	7 39 39	+273.7	Dec. 3......	6 7 32	−112.8	Feb. 12......	6 52 42	− 74.2
Sept. 24......	7 43 37	+ 41.3	Dec. 6......	6 46 58	−236.1	Feb. 12......	7 4 11	− 53.4
Sept. 25......	7 24 19	−141.0	Dec. 10......	6 0 41	−214.3			

MEAN PLACES OF COMPARISON STARS FOR 1898-99

Star	R. A.	Declination	Authority
1	20h 44m 11s.88	− 6° 20′ 26″.6	R. H. Tucker, Lick Observatory M.C.
2	20 43 18.61	− 6 18 45.7	R. H. Tucker, Lick Observatory M.C.
3	20 42 45.88	− 6 23 52.2	R. H. Tucker, Lick Observatory M.C.
4	20 38 49.07	− 6 19 16.2	R. H. Tucker, Lick Observatory M.C.
5	20 35 59.56	− 6 21 38.7	R. H. Tucker, Lick Observatory M.C.
6	20 38 34.89	− 6 3 27.7	Schj. 8242
7	21 37 45.57	− 2 20 25.5	½ (München I 29286 + München II 11916)
8	21 39 36.7	− 2 14.5	Compared with S.D. −2°5623
9	21 50 58.28	− 1 28 26.8	½ (Copeland and Börgen, Göttingen Cat. 6038+6039)
10	21 56 31.58	− 0 53 29.2	10m. Compared with ⅓(Copeland and Börgen, Göttingen Cat. 6076+6077+6078
11	22 5 1.1	− 0 22.0	B.D. −0°4316
12	....	....	9.75m star
13	22 19 25.37	+ 0 53 21.3	12m. Compared with *π Aquarii*
14	23 35 24.60	+ 7 28 10.2	Leipzig A.G.C. 11727
15	23 51 2.12	+ 8 58 28.8	9.6m. Compared with Leipzig A.G.C. 11836
16	0 10 46.0	+10 35.1	B.D. +10°20
17	0 12 59.69	+10 48 9.0	Compared with Leipzig A.G.C., No. 69
18	0 27 48±	+12 7.4±	Approximate from ephemeris
19	0 44 41.87	+13 31 8.9	9.7m. Compared with W.B. 0h754

MICROMETRICAL OBSERVATIONS OF *EROS* IN 1900

Date — 1900	90 Time	Comp. Star	No. Comp.	Planet-Star Δα	Planet-Star Δδ	Apparent α	Apparent δ	Parallax Factors α	Parallax Factors δ	Red. to Apparent α	Red. to Apparent δ
July 30	14h 6m 35s	Neb	2	...	+0′ 8″.6	...	...	...	+3′.64	...	+12″.7
	14 13 43	Neb	3	+0m 7s.87	...	...	...	−0s.312	...	+3s.41	...
	14 23 51	1	2	...	−1 12.3	...	+22 16″.6	...	+3.52	...	+12.7
	14 35 19	1	2	...	−1 21.6	...	+22 16.1	...	+3.45	...	+12.7
Aug. 1	13 20 25	2	4	...	+4 59.4	...	+22 58.5	...	+3.89	...	+12.6
	13 31 42	2	4	−0 29.92	...	1h 38m 38s.8	...	−0.356	...	+3.47	...
	13 41 27	2	4	...	+5 18.3	...	+22 58.8	...	+3.72	...	...
Aug. 4	14 16 36	3	3	...	+0 38.5	...	+24 0.1	...	+3.29	...	+12.5
	14 25 9	3	5	−0 21.34	...	1 43 20.62	...	−0.264	...	+3.56	...
	14 33 23	3	3	...	+0 52.7	...	+24 0.4	...	+3.17	...	+12.5
Aug. 5	14 37 14	4	3	...	+2 51.3	...	+24° 19′ 32″.5	...	+3.08	...	+12.5
	14 44 59	4	4	−0 0.19	...	1 14 53.85	...	−0.227	...	+3.60	...
	14 51 46	4	3	...	+3 3.1	...	+24 19 44.3	...	+3.00	...	+12.5
Aug. 6	15 13 51	5	3	...	+1 5.9	...	...	...	+2.85	...	+12.4
	15 18 9	5	4	+0 17.27	...	...	...	−0.163	...	+3.67	...
	15 23 9	5	4	...	+1 14.1	...	...	...	+2.80	...	+12.4
Aug. 20	15 36 1	6	4	...	+0 35.4	...	+29 30.6	...	+1.97	+4.10	...
	15 43 40	6	5	+0 0.65	...	2 6 47.8	...	−0.012	...	...	+12.2
	15 51 19	6	4	...	+0 48.9	...	+29 30.8	...	+0 15	+4.10	...
Aug. 27	15 58 6	7	3	...	+1 0.9	...	...	...	+1.60	...	+12.0
	16 2 34	7	5	−0 3.90	...	...	...	+0.010	...	+1.32	...
	16 6 50	7	..	...	+1 8.9	...	...	...	+1.61	...	+12.0
Sept. 3	13 2 21	8	4	...	+1 1.0	...	+31 30 27.9	...	+1.90	...	+11.7
	13 10 32	8.5	4	...	−1 0.1	...	+31 30 36.1	...	...	...	...

MICROMETRICAL OBSERVATIONS OF *EROS* IN 1900—*Continued*

Date—1900 90° Time	Comp. Star	No. Comp.	Planet-Star Δα	Planet-Star Δδ	Apparent α	Apparent δ	Parallax Factors α	Parallax Factors δ	Red. to Apparent α	Red. to Apparent δ
Sept. 3 13 17 2	8.5	4	−0m 4s.28	....	2h 24m 26s.54	....	−0s.280	......	+4s.61	......
13 22 37	8.5	4	....	−0′ 49″.13	....	+34° 30′ 47″.4	....	......	......	......
Sept. 4 15 16 12	9	4	....	−1 22.9	....	+34 54 39.9	....	+1″.15	......	+11″.7
15 20 47	9	4	−0 1.66	....	2 25 39.64	....	−0.266	......	+4.65	......
15 24 49	9	3	....	−1 15.0	....	+34 54 47.8	....	+1.15	......	+11.7
Sept. 10 13 7 30	10	4	....	+2 13.1	....	+37 6 57 1	....	+1.32	......	+11.6
13 15 54	10	5	−0 16.97	....	2 31 50.80	....	−0.250	......	+4.86	......
13 23 32	10	5	....	+2 29.2	....	+37 7 13.2	....	+1.19	......	+11.6
Sept. 11 13 26 7	11	4	....	−1 31.7	....	....	....	+1.10	......	+11.4
14 8 46	11	6	+0 34.81	....	2 32 49.66	....	−0.260	......	+4.94	......
14 25 49	11	4	....	−0 35.2	....	....	....	+0.80	......	+11.4
Sept. 13 16 11 5	12	5	....	−1 34.1[1]	....	+38 17 51.3	....	+0.78	......	+11.5
16 30 35	12	4	−0 18.63	....	2 34 43.05	....	+0.198	......	+5.02	......
16 35 0	13	5	−0 13.54	....	2 34 43.17	....	+0.205	......	+5.02	......
16 41 48	14	5	+0 6.37	....	2 34 43.47	....	+0.220	......	+5.02	......
16 46 37	13	5	....	−1 42.5[1]	....	+38 18 34.5	....	+1.00	......	+11.5
Sept. 19 12 2 18	15	6	....	+1 9.2	....	+40 30 42.1	....	+1.21	......	+11.7
12 15 35	15	6	−0 19.20	....:....	2 39 14.83	....	−0.330	......	+5.30	......
12 26 5	15	6	....	+1 32.4	....	+40 31 5.3	....	+0.95	......	+11.7
Sept. 27 13 6 25	16	4	....	+2 38.4	....	+43 35.8	....	0.00	......	+11.9
13 16 53	16	8	−0 46.19	....	2 42 33.6	....	−0.133	......	+5.64	......
13 31 24	17	4	....	−0 5.6	....	....	....	−0.12	......	+11.9
13 37 52	17	5	+0 9.76	....	....	....	−0.082	......	+5.64	......
13 48 47	17	5	....	+0 10.8	....	....	....	−0.15	......	+11.9

MEASURED DIFFERENCES OF RIGHT ASCENSION

Date—1900	90th Meridian Time	Δα in Arc Planet-Star	Date—1900	90th Meridian Time	Δα in Arc Planet-Star	Date—1900	90th Meridian Time	Δα in Arc Planet-Star
July 30......	14h 13m 43s	+109″.2	Aug. 27....	16h 2m 34s	− 44″.6	Sept. 13....	16h 35m 0s	−159″.3
Aug. 1......	13 31 42	−413.0	Sept. 4....	15 20 47	− 20.4	Sept. 13....	16 41 48	+ 74.9
Aug. 4......	14 25 9	−293.2	Sept. 10....	13 15 54	−205.4	Sept. 19....	12 15 35	−218.9
Aug. 6......	15 18 9	+235.3	Sept. 11....	14 8 46	+414.4	Sept. 27....	13 37 52	+106.0
Aug. 20......	15 43 40	+ 8.4	Sept. 13....	16 30 35	−219.2	....	....	....

MEAN PLACES OF COMPARISON STARS, 1900.0

Stars	R. A.	Declination	Authority
1	1h 36m 49s.4	+22° 17′.6	B.D. +22°261
2	1 39 5.2	+22 53.3	B.D. +22°265
3	1 43 38.4	+23 59.3	B.D. +23°242
4	1 44 50.44	+24 16 28″.7	12m. Compared with Berlin A.G.C. 542
5	....	....	12.3m star
6	2 6 43.1	+29 29.8	12m. Compared with B.D. 29°373
7	2 11 48.8	+31 56.6	B.D. +31°408
8	2 25 3.88	+34 29 15.2	Leiden A.G.C. 933
8½	2 24 26.21	+34 31 24.8	10.5m. Compared with Leiden A.G.C. 933
9	2 25 36.65	+34 55 51.1	11m. Compared with Leiden A.G.C. 935
10	2 32 2.91	+37 4 32.4	Lund A.G.C. 1291
11	2 32 9.91	+37 31 9.3	Lund A.G.C. 1295
12	2 34 56.66	+38 19 13.7	10.2m. Compared with 14 = *d*
13	2 34 51.69	+38 20 5.5	10.2m. Compared with 14 = *e*
14	2 34 32.08	+38 19 55.3	10.0m. Compared with Lund A.G.C. 1273 = *a*
15	2 39 28.74	+40 29 21.2	Bonn A.G.C. 2351.
16	2 43 14.2	+43 33.0	B.D. +43.585.
17	....	....	10.5m star

[1] One of these is 1r (9″.67) in error—probably the last one.

MICROMETRICAL MEASURES OF COMPARISON STARS

COMPARISON STAR FOR 1898, NOV. 27

Compared with S.D. 2°5623

13m star precedes 0′ 25″.43 (7) = 1s.69
13m star north 5′ 24″.47 (4)

COMPARISON STAR FOR 1898, DEC. 6

Compared with ⅓ (Copeland & Börgen, Göttingen Cat. 6076 + 6077 + 6078)

10m star precedes 0m 9s.49 (5)
10m star south 41. 36″.6 (4)

COMPARISON STAR FOR 1898, DEC. 17

Compared with π *Aquarii*

12m star precedes 9′ 40″.71 (4) = 38s.72 (using an intermediate star)
12m star north 1′ 46″.19 (4)
Direct $\Delta\alpha$ by transit gave $\Delta\alpha$ = 38s.37 (18)

COMPARISON STAR FOR 1899, FEB. 1

Compared with Leipzig A.G.C. 69

12m star preceding 2′ 17″.07 (4) = 9s.30
12m star north 9′ 22″.8 (4) (using several intermediate stars)

COMPARISON STAR FOR 1899, FEB. 12

Compared with W.B. 0h.754

9.7m star precedes 1m 13s.72 (10)
9.7m star south 1′ 0″.56 (3)

COMPARISON STAR FOR 1899, JAN. 24

Compared with Leipzig A.G.C. No. 11836

9.6m star precedes 2m 36s.90 (8)
9.6m star south 0′ 50″.19 (3)

COMPARISON STAR FOR 1899, JAN. 31

Compared with B.D.M. + 10°23

9.5m star precedes 1m 24s.25 (8)
9.5m star south 3′ 54″.06 (3)

COMPARISON STAR FOR 1900, AUG. 5

Compared with Berlin A.G.C. 542

12m follows 0m 36s.68 (18)
12m north 0′ 52″.08 (3)

COMPARISON STAR FOR 1900, AUG. 20

Compared with B.D.+29°373

12m star precedes 0m 24s.33 (16)
12m star south 2′ 45″.80 (4)

COMPARISON STAR FOR 1900, SEPT. 3

Compared with Leiden A.G.C. 933

10m star precedes 0m 37s.67 (16)
10m star north 2′ 9″.65 (4)

COMPARISON STAR FOR 1900, SEPT. 4

12m star follows 0m 29s.98 (14)
12m star south 1′ 27″.56 (4)

COMPARISON STARS FOR 1900, SEPT. 13

Compared with Lund A.G.C. 1273

Star *a*

a follows 1273 3m 49s.83 (6)
a north 1′ 41″.22 (2)

Now compare *b*, *c*, *d* with *a*:

b follows *a* 0m 11s.76
b north of *a* 1′ 2″.88
c follows *a* 0m 19s.61
c north 0′ 10″.17
d follows *a* 0m 21s.58
d south 0′ 30″.97

These $\Delta\alpha$ and $\Delta\delta$ with respect to *a* are from the following position angles and distances:

a and *b*	65°.56 (4)	distance 151″.94 (4 single dist.)
b and *c*	119.53 (4)	106.94 (4 " ")
c and *d*	131.53 (4)	78.13 (4 " ")

The star *b* of the 10.3m was not used in the observations of *Eros*.

In the observations of 1900, September 10, the planet was referred to the Lund star through a 10.5m star.

10.5m star precedes A.G.C. 1291 by 208″.00 (6 obs.) = 0m 17s.38
10.5m north A.G.C. 1291 by 0′ 54″.10 (5 obs.)
Place of 10.5m star; 1900.0 2h 31m 45s.54 + 37° 5′ 26″.2

In the first two measures of 1900, July 30, the planet was referred to an unknown nebula.

I wish to express my thanks to Professor R. H. Tucker, of the Lick Observatory, for special observations of some of the comparison stars. I am also very greatly obliged to Professor William H. Hussey, of the Lick Observatory, for supplying me with star places from the various star catalogues in the library of the Lick Observatory not available here, and also for a manuscript copy of his accurate ephemeris of *Eros* for the identification of comparison stars.

I am also indebted to Professor S. J. Brown, of the U. S. Naval Observatory, for catalogue places of some of the stars.

ESTIMATIONS OF THE BRIGHTNESS OF *EROS*

The remarkable variations in the light of *Eros* which are shown to have occurred during the apparition of 1900–1901 have added a much greater interest to the planet. The cause of these light changes is yet a mystery, though several more or less plausible explanations have been brought forward. During the observations made here this peculiarity was not known, having developed later on. No special observations were therefore made of its brightness. I find, however, in going over the measures with the 40-inch, that *Eros* was carefully compared in brightness with various stars near it, not only in the measures of 1900, but also in 1898 within a short time of the discovery of the planet. These stars can readily be identified in the sky and their magnitudes determined, from which an accurate value can be had of the light of *Eros* on some eight or nine nights in 1898 and on over thirty nights in 1900. Since, in the great majority of cases, the brightness of *Eros* differed only a fraction of a magnitude from that of the star, the comparisons will be very accurate and should be very important in connection with the singular variation of the light of the planet.

That these observations may be made available, I have collected them here with all the data required for the identification of the comparison stars when used with an accurate ephemeris of *Eros*.

The stars referred to are those used at the time of observation for the position of the planet, if not otherwise stated.

The times herein contained are 90th meridian time, which is $6^h\,0^m\,0^s$ slow of Greenwich mean time.

1898

September 11: At $8^h\,11^m\,45^s$ *Eros* was 1″.14 north of a small star. A few seconds before this it had passed within about 0″.6 of the star — the two appearing for a few moments as a beautiful double star. *Eros* was 0.2m less than the star.

On September 12 the position of this star was measured with reference to the comparison star of September 11. $\Delta\alpha$ 4′ 1″.15 (6) $\Delta\delta$ 2′ 11″.55 (3) south following the comparison star of September 11.

September 20, $9^h\,0^m$: *Eros* estimated at 11.8m. There are two stars, one south following *Eros* 2½′, the other north following 3′. These are of about equal magnitude. *Eros* is 0.1m less than either star.

September 21: At $9^h\,1^m\,40^s$ *Eros* followed an 11m star by 17″.05 (4) and was ½′± north of the star. The planet was 0.5m less than this star. A similar star was about ½′ north preceding *Eros*. *Eros* was also 0.5m less than this star.

September 24: At $7^h\,40^m$ *Eros* is 0.2m less than a small star that is close south following the 7.7m comparison star. The estimated magnitude of *Eros* was 11.5m.

September 26, $8^h\,11^m$: *Eros* is 7″ or 8″ south of a small double star [P.A. 271°.5 (4) distance 3″.75 (4)]. 1′ south of these is a small star exactly the same magnitude as *Eros*. There are two somewhat brighter stars 2′ or more south of this star.

October 11: At $7^h\,25^m$ *Eros* is 12″.8 south of a small star and follows it 1½′±. *Eros* is 0.1m brighter than this star.

December 10, $6^h\,17^m$: 2½′ preceding *Eros* is a small star. The planet is exactly the same magnitude as this star.

1899

January 31, $7^h\,0^m$: Estimated magnitude = 11. It is bright and easy. There are two stars 3′ or 4′ preceding. It is brighter than either of these stars.

February 12, $7^h\,10^m$: 2½′ following the comparison star are two small stars. *Eros* is exactly the same brightness as these.

1900

August 4, $14^h\,35^m$: *Eros* about 12.2m.

August 6, $15^h\,18^m$: *Eros* 0.1m brighter than the comparison star. The planet is estimated to be 12m.

August 7, $13^h\,50^m$: Estimated at 12.2m. There is a star of the same brightness as the planet preceding 4′ and 1½′ north.

August 20, $15^h\,55^m$: There are two stars marked 12.1m 1′ and 2′ south preceding the planet. *Eros* is 0.1m brighter than these.

August 27, $16^h\,10^m$: There is an 11.5m star 1½′ following the comparison star which is exactly the same brightness as *Eros*.

September 3, $13^h 25^m$: Estimated magnitude, 11.5m. *Eros* is 0.5m or 0.7m less than the 10.5m comparison star.

September 10, $13^h 20^m$: Estimated magnitude, 11m. Small comparison star estimated at 10.5m .

September 13, $16^h 25^m$: Estimated at 10.7m. The estimations for the stars near were $a = 10$m, $b = 10.2$m, $c = 10$m, $d = 10$m.

September 19, $12^h 30^m$: There is an 11m star 2' preceding and $\frac{1}{2}' \pm$ north, exactly the same magnitude as *Eros*.

September 27, $13^h 50^m$: *Eros* and the 10.5m comparison star are of the same brightness—possibly *Eros* is very slightly the brighter.

October 2, $8^h 40^m$: *Eros* 0.5m brighter than star 1.

October 4, $12^h 25^m$: Estimated at 10m. It is 0.3m brighter than the comparison star.

October 9, $8^h 5^m$: Estimated at 10m. Star 1 is 12.2m; star 2 is 12m; star 3 is 12.5m. Same date, $16^h 20^m$: *Eros* 0.7m less than star 1. Same date, $16^h 40^m$: A little less than star 1, perhaps 0.5m.

October 25, $18^h 2^m$: *Eros* still easily visible on the bright sky. The comparison stars have all faded out.

November 1, $17^h 50^m$: Estimated at 9.8m. It is exactly the same brightness as star 1 and 0.2m brighter than star 2.

November 2, $12^h 50^m$: It is from 0.1m to 0.2m brighter than star 2 and 0.3m brighter than star 1.

November 11, $6^h 50^m$: It is 0.2m brighter than the comparison star. Same date, $8^h 20^m$: It is 0.3m brighter than the comparison star. The comparison star estimated at 9.7m.

November 13, $18^h 10^m$: It is 0.2m brighter than star 2.

November 22, $8^h 50^m$: It is 0.25m brighter than star 2 and about 0.7m brighter than star 1. It is much easier than star 2.

November 23, $10^h 0^m$: It is 05.m ± brighter than the comparison star.

November 25, $18^h 0^m$: It is 0.5m brighter than either star 3 or star 4, which are equal.

December 5, $9^h 30^m$: It is 0.5m or 0.7m brighter than star 1. Same date, $14^h 0^m$: It is 0.5m brighter than the comparison star.

December 8, $7^h 10^m$: It is nearly 1m brighter than the comparison star. Same date, $14^h 20^m$: It is from 0.5m to 0.7m brighter than the comparison star.

December 12, $6^h 0^m$: It is 1m brighter than star 2. It is 0.7m or 0.8m less than star 1.

December 18, $12^h 52^m$: It is 0.3m brighter than the comparison star. The star estimated at 8.8m.

December 29, $5^h 40^m$: It is the same magnitude as the comparison star.

December 31, $6^h 50^m$: It is the same brightness as the comparison star—possibly very slightly brighter.

1901

January 14, $10^h 25^m$: It is from 0.5m to 0.7m brighter than the comparison star.

January 19, $6^h 10^m$: It is 0.7m brighter than star 1.

January 21, $10^h 30^m$: It is less than the comparison star. Same date, $11^h 0^m$: It is from 0.1m to 0.2m less than the comparison star, and is slightly yellowish.

January 24, $6^h 10^m$: It is 1m less than the comparison star. Same date, $9^h 50^m$: It is 0.5m brighter than the comparison star.

January 25, $7^h 10^m$: It is 0.1m brighter than star 1.

February 5, $10^h 50^m$: It is 0.2m brighter than the comparison star, which is about 10m.

METHODS OF TREATING PROBLEMS IN CELESTIAL MECHANICS

ON CERTAIN RIGOROUS METHODS OF TREATING PROBLEMS IN CELESTIAL MECHANICS

F. R. MOULTON

§ 1. INTRODUCTION

MATHEMATICAL science was not sufficiently developed to enable the founders of celestial mechanics to prove in many cases the validity of the methods which they found it necessary to employ. Doubtless, too, mathematicians of a century and more ago did not realize so keenly as they do at present the necessity of relying only upon those processes which have been proved to be legitimate. In both pure mathematics and astronomy many conclusions were drawn which have since been shown to be erroneous or which still lack proof. Celestial mechanics has been filled with series, comparatively few of which have been proved to be convergent. It may be said by way of excuse, however, that the problems which astronomers have been called upon to solve have been almost invariably of great difficulty, and their powers have been sufficiently taxed to obtain formal solutions which would agree with observations.

The critical attitude respecting the convergence of series may safely be said to date from the researches of Abel on the hypergeometric series in 1826, and to have received its greatest early impulse from the researches of Cauchy in the theory of functions of complex variables. The latter half of the nineteenth century witnessed a complete re-examination of the foundations of analysis, the correction of numerous errors, and the introduction of an entirely new spirit of rigor.

It is worthy of remark that many mathematical processes, especially those used in integrating total differential equations, have had their origin in attempts to solve astronomical problems. After having been started they have been developed in the realm of pure mathematics far beyond their astronomical applications; and, with the exception of the epoch-making researches of Poincaré (1892–98), the improvements in the methods of celestial mechanics and the standard of rigor maintained have in no way kept pace with these developments. The question is pertinent whether those interested in celestial mechanics should not henceforth adhere more nearly, if not entirely, to methods which are known to be rigorous.

In this paper it is proposed to show how some of the important problems of celestial mechanics may be treated by processes which are proved to be valid at least within prescribed limits. These problems will depend upon the integration of total differential equations in series, and the central question will relate to the convergency of the series. It will be shown how certain of the standard methods are valid for not too great values of the time, and how other problems can be solved. It will be shown that, if the initial conditions are known, it is possible to construct series which will represent the co-ordinates of the moon with any desired degree of accuracy for any desired length of time, provided it does not go outside of an arbitrary anchor ring inclosing its present orbit, and that the number of terms which will be sufficient can be determined in advance; it will be shown that the usual method of computing absolute perturbations has a certain realm of validity, and that the terms of different orders have simple physical interpretations; it will be shown how the secular terms of the first order can be avoided in the mutual perturbations of the planets, giving results in some respects similar to those obtained by the methods of Lagrange, but in others essentially different; and it will be shown that the higher terms in Hill's celebrated lunar theory can be defined in such a manner that the theory as a whole has a positive realm of validity.

§2. POWER SERIES IN THE TIME[1]

The first and simplest method of integrating differential equations of the type occurring in considering the motions of the planets and satellites is to develop the solutions as power series in the independent variable. The usefulness of this method in astronomical problems is quite limited because of the small value of the time for which the series converge. As this is the best-known method of integrating differential equations, a mere outline of the steps and the proof of their validity will be sufficient.

The differential equations of motion of k mutually attracting spheres may be written in the form

$$\frac{dx_i}{dt} = X_i(x_1, \cdots, x_n t) \qquad (i=1, \cdots, n), \quad (n=6k), \tag{1}$$

where the X_i are all analytic functions of $x_1, \cdots, x_n$ and t. If the bodies are not spheres, but of some known form, as oblate spheroids, the number of differential equations is doubled for a given number of bodies. If the bodies are spheres, and if the x_i are the rectangular co-ordinates and the components of velocity, the right members of (1) will not involve the time explicitly. There is no loss in generality in supposing that at the origin of time $t=0$, $x_i=0$ $(i=1, \cdots, n)$; for, if it were not so, a convenient transformation of variables would secure these conditions. In all astronomical problems the X_i are all regular for $x_i=0$ $(i=1, \cdots, n)$, $t=0$.

To find the solutions, suppose the X_i are developed as power series in $x_i, \cdots, x_n$, t as

$$\frac{dx_i}{dt} = \sum_{j_1, \cdots, j_n, k=0}^{\infty} a^{(i)}_{(j_1, \cdots, j_n, k)} x_1^{j_1} x_2^{j_2} \cdots x_n^{j_n} t^k \qquad (i=1, \cdots, n), \tag{2}$$

expansions which, under the conditions stated, converge for sufficiently small $x_i, \cdots, x_n$ and t. The solutions are to have the form

$$x_i = \sum_{j=1}^{\infty} c_j^{(i)} t^j \qquad (i=1, \cdots, n). \tag{3}$$

If equations (3) are substituted in (2) and the coefficients of corresponding powers of t equated in the two members, it will be found that all of the $c_j^{(i)}$ can be determined uniquely in the order of increasing values of j.

It only remains to prove that the series (3) have positive radii of convergency. This is done by using a comparison system of differential equations

$$\frac{dy_i}{dt} = Y_i(y_1, \cdots, y_n, t) \qquad (i=1, \cdots, n), \tag{1'}$$

where the Y_i fulfil all the conditions imposed upon the X_i, and the additional ones that every coefficient of their expansions shall be real and positive and greater than the modulus of the corresponding coefficient in the expansions of the X_i. Suppose further that the solutions of (1′) are

$$y_i = \sum_{j=1}^{\infty} b_j^{(i)} t^j \qquad (i=1, \cdots, n), \tag{3'}$$

where the coefficients $b_j^{(i)}$ are determined as the $c_j^{(i)}$ were. It is easily shown, then, that every $b_j^{(i)}$ is real and positive and greater than the modulus of the corresponding $c_j^{(i)}$. Consequently, (3) converge for at least as large values of t as (3′) do.

All of the conditions imposed upon (1′) can be fulfilled by equations of the form[2]

$$\frac{dy_i}{dt} = \frac{C}{[1-\alpha(y_1 + \cdots + y_n)][1-\beta t]}, \tag{1''}$$

[1] The first proof of the convergence of the series obtained by this method was given by CAUCHY in the *Comptes rendus*, July, 1842; *Collected Works*, 1st series, Vol. VII.

[2] See JORDAN, *Cours d'analyse*, Vol. I, p. 197.

where C, a, β are real positive constants. Integrating these equations, determining the constants of integration by the condition that $y_i = 0$ for $t = 0$ and solving for y_i, it is found that

$$y_i = 1 - \sqrt{1 + \frac{2na C}{\beta} \log(1 - \beta t)} \ . \tag{3''}$$

It follows from this equation that the y_i can be expanded in converging power series in t if

$$\begin{aligned} |t| &< \frac{1}{\beta} \ , \\ |t| &< \frac{1}{\beta}\left(1 - e^{-\frac{\beta}{2naC}}\right) \ , \end{aligned} \tag{4}$$

inequalities which can always be fulfilled by finite values of t for finite values of a, β, and C. Consequently the series (3) converge for sufficiently small values of the time.

A defect of the method just outlined is that it does not give the true radius of convergence of the series. Picard has shown,[3] indeed, that the limit imposed on t by the inequalities (4) is always smaller than the true radius of convergence.

§3. APPLICATION OF MITTAG-LEFFLER'S GENERALIZED POWER SERIES

As has been remarked, the series (3) in most practical problems converge for only a short interval of time. Since the singularities of the right members of (1) are isolated, the singularities of (3) are also isolated; hence equations (3) define the values of the x_i for all values of t by the Weierstrassian continuation of power series. But to continue power series by the method of Weierstrass, it is necessary to know the location of the singularities, the very thing that is unknown when the series is defined by non-linear differential equations. In addition to this, the work of actually continuing power series is so great as seriously to impair the value of the method even when the positions of the singular points are known.

Part of these difficulties have been overcome by Mittag-Leffler[4] in his researches on methods of representing analytic functions in extended regions of the complex plane by generalizations of power series.

For simplicity let any of equations (3) be written in the form

$$x = \sum_{i=1}^{\infty} a_i t^i \ , \tag{5}$$

where now t is a complex variable. Suppose this series converges so long as $|t| < t_0$. Mittag-Leffler has shown in *loc. cit.* how to construct a series of series out of t and the coefficients a_i associated with the point $t = 0$ which shall be uniformly convergent in a widely extended region which he called a *star*.

There is a star A_n associated with the coefficients a_i for every positive integer n, which is defined as follows[5]: With $t = 0$ as the origin draw any vector. The positive quantity r may be chosen so small that if the length of the vector is taken as $(n-1)r$, then every circle whose radius is r and whose center is on the vector will contain none but regular points in its interior or on its boundary. Let ρ be the upper limit of the values of r for which these conditions are fulfilled. If the length $n\rho$ is taken on the vector, and if the vector makes a complete revolution, the value of ρ for each position being taken, the star A_n will be generated. Evidently the star A_1 is the true circle of convergence of the series (5), and every star A_n includes the star A_{n-1}. From the series of series a series of polynomials depending upon the a_i and n may be constructed in an infinity of ways which will represent the function uniformly in A_n with an error less than an arbitrary ϵ given in advance.[6]

[3] *Bulletin des sciences mathématiques*, 1888, p. 148.

[4] *Acta Mathematica*, Vol. XXIII, p. 43, and Vol. XXIV, pp. 183, 205.

[5] *Ibid.*, Vol. XXIII, p. 47.

[6] *Ibid.*, p. 62.

The difficulty in applying this theorem is that there is no way of determining whether a given point belongs to any star A_n or not. When the series (5) is defined by differential equations, this part of the question becomes considerably simplified. Suppose (5) has been defined by the differential equations which the motion of the moon must fulfil. Then it will be known to converge if $|t| < t_0$, the value of t_0 depending on the initial values of the co-ordinates. Suppose that during the whole interval of time $0 \gtreqless t \leqq T$ the moon is contained within an anchor ring with the earth as center. For every point in this anchor ring as an initial point there is a corresponding t_0. Let the least value of these numbers t_0 be ρ. Now, if the initial conditions are known, it is possible to construct a Mittag-Leffler series of polynomials having a number of terms which can be determined in advance, which will give the value of x with an error less than an arbitrary ϵ for the whole interval of time $0 \gtreqless t \leqq T$.

In order to apply Mittag-Lefflers's process the point $t = T$ must belong to the star A_n, where the number n is to be determined. From the definition of the star it is seen that it suffices to take n so that $n\rho \geqq T$. Then the series of polynomials may be set up, the polynomials depending on both n and the required accuracy ϵ. With this series of polynomials an ephemeris may be computed, and if the moon does not pass out of the anchor ring which was used in defining ρ, and through it n, the final results will be in error less than ϵ. If the moon should pass out of the anchor ring as given by the ephemeris, the results will be in error less than ϵ up to the time it crosses the ring. At this point a new ring could be taken. In this manner it is possible to construct a theoretically perfect lunar theory.[7]

§4. THE METHOD OF THE VARIATION OF PARAMETERS

The method of variation of parameters, which was partially developed by Euler in his memoirs on the lunar theory, and which was finished by Lagrange in his work on the mutual perturbations of the planets, has been one of very great usefulness in astronomy. Owing to the immense details connected with its applications and to the fact that because of the small masses of the planets only one step of any possible number of steps is required, much confusion has arisen regarding the mathematical features of the process. For example, it is frequently supposed that each step is only a process of approximation.

Consider equations (1) and suppose their right members are series of any sort, except that, if they are infinite, they converge at least in the vicinity of the initial values of the x_i and t. Then (1) may be written

$$\frac{dx_i}{dt} = X_i^{(1)} + X_i^{(2)} + X_i^{(3)} + \cdots \qquad (i=1, \cdots, n) \ . \tag{6}$$

Now consider the differential equations

$$\frac{dx_i}{dt} = X_i^{(1)} \qquad (i=1, \cdots, n) \ , \tag{7}$$

where the $X_i^{(1)}$ are any terms of the right members of (6). In practice the $X_i^{(1)}$ are generally the largest terms, but this is not in the least essential to the method. Suppose the solutions of (7) can be exactly found, at least for sufficiently small values of t, and that they are

$$x_i = f_i^{(1)}(y_1, \cdots, y_n, t) \qquad (i=1, \cdots, n) \ , \tag{8}$$

where $y_1, \cdots, y_n$ are the constants of integration. Suppose these equations are valid if $0 \gtreqless t < T$, where T may be infinite.

Since equations (8) are the solutions of (7) if they are substituted in (7), these expressions reduce to identities in $y_1, \cdots, y_n$ and t for all values of t less than T.

[7] Compare the note by Painlevé in *Comptes rendus*, June 19, 1899; see also note by PICARD, *ibid.*, June 5, 1899.

Now regard equations (8) as equations of transformation expressing the n old variables x_i in terms of n new variables y_i. The transformation is made by substituting (8) directly in (6), whence

$$\frac{\partial f_i^{(1)}}{\partial t}+\sum_{j=1}^{n}\frac{\partial f_i^{(1)}}{\partial y_j}\frac{d y_j}{d t}=X_i^{(1)}(y_1,\cdots,y_n,t)+X_i^{(2)}(y_1,\cdots,y_n,t)+\cdots \qquad (i=1,\ldots,n) . \quad (9)$$

Since equations (8) are the solutions of (7), it follows from the definition of solutions that

$$\frac{\partial f_i^{(1)}}{\partial t}\equiv X_i^{(1)}(y_1,\cdots,y_n,t) \quad (i=1,\ldots,n) \quad \text{in } y_1,\cdots,y_n \text{ and } t ,$$

and equations (9) become

$$\sum_{j=1}^{n}\frac{\partial f_i^{(1)}}{\partial y_j}\frac{d y_j}{d t}=X_i^{(2)}(y_1,\cdots,y_n,t)+\cdots \qquad (i=1,\ldots,n) . \quad (10)$$

This vanishing of the first terms in the right members, which in practice are much larger than the succeeding ones, constitutes the essential mathematical difference between the method of the variation of parameters and an ordinary transformation of variables.

Equations (10) are linear in the derivatives $\frac{d y_j}{d t}$ and may be solved for them, giving

$$\frac{d y_i}{d t}=Y_i^{(1)}+Y_i^{(2)}+\cdots \qquad (i=1,\ldots,n) , \quad (11)$$

where the right members are written as series constructed according to any desired plan. Equations (11) are valid for all values of t less than T if the determinant of the left members of (10), which is the Jacobian of (8), does not vanish in this interval. The Jacobian does not vanish identically, for equations (8) are independent, being the solutions of equations (7), which are by hypothesis independent. It may become zero, however, for special values of $y_1,\cdots,y_n$ and t. But if equations (6) are in the canonical form, as they can always be written, in considering the motions of the planets as well as in much more general problems, and if the canonical constants are used, the determinant is unity and never vanishes.

In considering the perturbations of the planets the canonical elements are not generally used. When they are not, the determinant will vanish if the x_i take such values that the solutions of equations (8) for the y_i give ambiguous or infinite results. When the ordinary elements a, e, i, Ω, $\tilde{\omega}$, and ϵ are used, $\tilde{\omega}$ becomes indeterminate for $e=0$, Ω for $i=0$, and a becomes infinite for $e=1$; for these values of e and i the determinant of (10) vanishes. This is one of the reasons why Lagrange transformed from e and $\tilde{\omega}$ to h and l, and from i and Ω to p and q in treating the secular terms.

After equations (11) have been found, the problem of integrating them arises, and is in general no less difficult than was the integration of (6). Equations (11) have the same form as (6) and may be treated in the same way, giving, after completing the reductions,

$$\frac{d z_i}{d t}=Z_i^{(1)}+Z_i^{(2)}+\cdots \qquad (i=1,\ldots,n) . \quad (12)$$

This process may be continued indefinitely if the first terms in the right members are selected so that when the others are neglected the rigorous integration can be performed. Under these conditions it is perfectly valid for any finite number of repetitions, the question whether it converges when repeated indefinitely remaining unanswered. To treat this question it would be necessary to define in some way the law of procedure.

The method of variation of parameters finds its complete exemplification only in Delaunay's lunar theory where it is consistently followed out. In the theories of the perturbations of the planets it is the first step, after which the method is changed.

§5. POWER SERIES IN PARAMETERS

The power series in the time given in § 2 are not convenient in most problems because of their small realm of convergence. Nevertheless, it is possible to construct from them, as shown in § 3, series of polynomials which have a wider realm of convergence. If, instead of using polynomials, more general functions are employed, the practical usefulness of the series can be greatly increased. The most satisfactory method which has been so far devised is to expand the solutions as power series in the parameters which occur in the differential equations.[8] If no natural parameters occur, it is sometimes possible to introduce them artificially so as to attain much the same results.

Suppose the differential equations to be integrated are

$$\frac{dx_i}{dt} = X_i(x_1, \cdots, x_n, a, \beta, t) \qquad (i=1, \cdots, n) , \tag{13}$$

where a and β are parameters. Suppose the initial values of $x_1, \cdots, x_n$ are $a_1, \cdots, a_n$ respectively. Suppose the X_i are all expansible in converging power series in a in the vicinity of $x_j = a_j$ for all values of t such that $0 \leqq t < t_0$. Suppose the coefficients of the various powers of a are all expansible as converging power series in $x_1, \cdots, x_n$ in the vicinity of $x_j = a_j$ for all $0 \leqq t < t_0$.

It is proposed to find solutions having the form

$$x_i = \sum_{j=0}^{\infty} x_i^{(j)} a^j \qquad (i=1, \cdots, n) , \tag{14}$$

where the $x_i^{(j)}$ are functions of the time to be determined. In determining the $x_i^{(j)}$ there are two cases, depending on whether the X_i all vanish with $a = 0$ or not.

1. *Case in which the X_i have a factor a.*—In order to keep this fact prominent, let (13) be written in the form

$$\frac{dx_i}{dt} = a X_i(x_1, \cdots, x_n, a, \beta, t) . \tag{13'}$$

Substituting (14) in (13′), it is found that

$$\sum_{j=0}^{\infty} \frac{dx_i^{(j)}}{dt} a^j = X_i a + \frac{\partial X_i}{\partial a} a^2 + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(1)} a^2 + \frac{1}{2}\frac{\partial^2 X_i}{\partial a^2} a^3 + \sum_{j=1}^{n} \frac{\partial^2 X_i}{\partial a\, \partial x_j} x_j^{(1)} a^3 + \frac{1}{2} \sum_{j=1}^{n} \sum_{k=1}^{n} \frac{\partial^2 X_i}{\partial x_j \partial x_k} x_j^{(1)} x_k^{(1)} a^3$$
$$+ \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(2)} a^3 + \cdots , \tag{15}$$

where in all the partial derivatives x_i is replaced by $x_i^{(0)}$ and a is put equal to zero. Admitting for the moment the convergency of (15), the coefficients of the corresponding powers of a in the right and left members are equal, giving

$$\left\{\begin{aligned} &\frac{dx_i^{(0)}}{dt} = 0 \qquad (i=1, \cdots, n) , \\ &\frac{dx_i^{(1)}}{dt} = X_i(x_1^{(0)}, \cdots, x_n^{(0)}, 0, \beta, t) , \\ &\frac{dx_i^{(2)}}{dt} = \frac{\partial X_i}{\partial a} + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(1)} , \\ &\text{etc.} \end{aligned}\right. \tag{16}$$

These equations can be integrated in order, being in each case quadratures, and give the coefficients of (14) uniquely.

[8] This method was first used in a somewhat loose way by early workers in celestial mechanics in constructing the theories of the mutual perturbations of the planets. The indefinite "order of small quantities" was used and has been largely retained up to the present time, rather than an explicit development. CAUCHY in 1842 examined the validity of the method (*Collected Works*, 1st series, Vol. VII).

2. *Case in which the X_i do not have the factor α.*—Substituting (14) in (13), it is found that

$$\sum_{i=0}^{\infty} \frac{d x_i^{(j)}}{dt} \alpha^j = X_i(x_1^{(0)}, \cdots, x_n^{(0)}, 0, \beta, t) + \frac{\partial X_i}{\partial \alpha}\alpha + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(1)} \alpha + \frac{1}{2}\frac{\partial^2 X_i}{\partial \alpha^2}\alpha^2 + \sum_{j=1}^{n} \frac{\partial^2 X_i}{\partial \alpha\, \partial x_j} x_j^{(1)} \alpha^2$$
$$+ \frac{1}{2}\sum_{j=1}^{n}\sum_{k=1}^{n} \frac{\partial^2 X_i}{\partial x_j\, \partial x_k} x_j^{(1)} x_k^{(1)} \alpha^2 + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(2)} \alpha^2 + \cdots \,. \tag{17}$$

Equating coefficients of corresponding powers of α, it is found that

$$\begin{aligned}
\frac{d x_i^{(0)}}{dt} &= X_i(x_1^{(0)}, \cdots, x_n^{(0)}, 0, \beta, t) \qquad (i=1, \cdots, n)\,, \\
\frac{d x_i^{(1)}}{dt} &= \frac{\partial X_i}{\partial \alpha} + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(1)}\,, \\
\frac{d x_i^{(2)}}{dt} &= \frac{1}{2}\frac{\partial^2 X_i}{\partial \alpha^2} + \sum_{j=1}^{n} \frac{\partial^2 X_i}{\partial \alpha\, \partial x_j} x_j^{(1)} + \frac{1}{2}\sum_{j=1}^{n}\sum_{k=1}^{n} \frac{\partial^2 X_i}{\partial x_j\, \partial x_k} x_j^{(1)} x_k^{(1)} + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(2)}\,;
\end{aligned} \tag{18}$$

and in general

$$\frac{d x_i^{(\nu)}}{dt} = X_i^{(\nu)} + \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} x_j^{(\nu)}\,, \tag{19}$$

where $X_i^{(\nu)}$ is a polynomial in $x_j^{(0)}, \cdots, x_j^{(\nu-1)}$. After the $x_i^{(0)}$ have been determined, the remaining $x_i^{(\nu)}$ depend upon the solution of systems of linear non-homogeneous differential equations.

This case may always be avoided by eliminating the parts of the X_i which are independent of α by the method of the variation of parameters, but it is not always advisable to do so.

3. *Determination of constants of integration.*—Every time a set of equations of (16) is integrated n constants are introduced, and they must be determined in terms of the initial values of the variables. Let the constants introduced with $x_i^{(\nu)}$ be $a_i^{(\nu)}$; then, letting $x_i^{(\nu)}$ be written $f_i^{(\nu)}(t) - a_i^{(\nu)}$, equations (14) become

$$x_i = a_i^{(0)} + \sum_{j=1}^{\infty} [f_i^{(j)}(t) - a_i^{(j)}]\, \alpha^j \qquad (i=1, \cdots, n)\,.$$

At the initial time $t = 0$ these equations become

$$a_i = a_i^{(0)} + \sum_{j=1}^{\infty} [f^{(j)}(0) - a_i^{(j)}]\, \alpha^j \qquad (i=1, \cdots, n)\,. \tag{20}$$

If these equations have any realm of convergency in α for $0 \leqq t < t_0$, they become identities in α, because the initial values of the variables are independent of the parameters, and it follows that

$$\begin{aligned}
a_i^{(0)} &= a_i \qquad (i=1, \cdots, n)\,, \\
a_i^{(j)} &= f_i^{(j)}(0) \qquad (i=1, \cdots,\ j=1, \cdots, \infty)\,.
\end{aligned} \tag{21}$$

It follows from these relations that, when the X_i vanish with α, the $x_i^{(\nu)}$ are the definite integrals of the equations by which they are defined taken between the limits $t = 0$ and $t = t$.

When the X_i do not vanish with α, the constants are not additive. The way they enter in the expressions for $x_i^{(0)}$ depends upon the forms of the right members of the first set of equations (18). In the solutions of the linear equations which occur after the first set they enter in the form

$$x_i^{(\nu)} = \sum_{j=1}^{n} c_{ij}^{(\nu)} f_j^{(\nu)}(t) + \phi_i^{(\nu)}(t) \qquad (i=1, \cdots, n \quad \nu=1, \cdots \infty)\,, \tag{22}$$

where the $c_{ij}^{(\nu)}$ are related to the $c_{1j}^{(\nu)}$ $(i=2, \cdots, n)$ by the coefficients which are involved in the differential equations. At $t=0$ the solutions (14) become

$$a_i = x_i^{(0)} + \sum_{\nu=1}^{\infty} \left\{ \sum_{j=1}^{n} c_{ij}^{(\nu)} f_j^{(\nu)}(0) + \phi_i^{(\nu)}(0) \right\} a^\nu \qquad (i=1, \cdots, n) \ . \tag{23}$$

If these equations have any realm of convergency, they are identities in a. Hence $(x_i^{(0)})_{t=0} = a_i$, and the independent constants $c_{1j}^{(\nu)}$ which enter linearly are determined by the equations

$$\sum_{j=1}^{n} c_{ij}^{(\nu)} f_j^{(\nu)}(0) + \phi_i^{(\nu)}(0) = 0 \qquad (i=1, \cdots, n) \ , \tag{24}$$

and a similar system for all values of ν from 1 to ∞. It follows from this that the $x_i^{(\nu)}$ are the definite integrals

$$x_i^{(\nu)} = \int_0^t \frac{d x_i^{(\nu)}}{dt} dt \qquad (i=1, \cdots, n, \ \nu=1, \cdots \infty) \ .$$

The question of the convergency of these series was first examined by Cauchy in a series of papers published in *Comptes rendus* in the summer of 1842.[9] The method is to use a comparison set of differential equations,

$$\frac{d y_i}{dt} = Y_i(y_1, \cdots, y_n, a, \beta, t) \qquad (i=1, \cdots, n) \ , \tag{25}$$

where the Y_i fulfil all the conditions imposed upon the X_i, and the additional ones, that the coefficients of the expansions of the coefficients of the various powers of a shall be real, positive, and greater than the moduli of the corresponding coefficients in the expansions of the X_i for all $0 \leqq t < t_0$. Then it is shown that, if the solutions of (25) are written in the form

$$y_i = \sum_{j=0}^{\infty} y_i^{(j)} a^j \ , \tag{26}$$

the $y_i^{(j)}$ are all real, positive, and greater than the moduli of the corresponding coefficients of the series (14) for all $0 \leqq t < t_0$. Consequently series (14) converge if (26) converge.

There are always equations fulfilling the conditions imposed upon (25) of the form

$$\left.\begin{aligned} \frac{d y_i}{dt} &= \frac{a C}{(1-\rho a)\,[1 - r(y_1 + \cdots + y_n)]} \ , \quad \text{or} \\ \frac{d y_i}{dt} &= \frac{C}{(1-\rho a)\,[1 - r(y_1 + \cdots + y_n)]} \ , \end{aligned}\right\} \tag{27}$$

according as the right members vanish with a or not, and where C, ρ, and r are constants conveniently chosen. Equations (27) can be integrated and the y_i expressed as series in a which, from the form of the functions which are expanded, are known to converge if t and a are sufficiently small. Hence it follows that the series (14) converges if t and a are sufficiently small. The limits within which the series are certainly convergent determined in this way are undoubtedly in general much too small.

Poincaré has proved that for any finite value t_0 the a may be chosen so small that the series converges for all $0 \leqq t < t_0$, provided that the solutions of (14) with $a=0$ have no singularities for this range of time.[10] It follows equally that for any values of a for which the right members of (13) converge the t_0 may be taken so small that (14) converges for all $0 \leqq t < t_0$; and, therefore, any solutions of a problem which are constructed in this manner have at least a positive finite realm of validity in t.

The parameter β enters in the differential equations (13), and so far it has not been defined,

[9] *Collected Works*, 1st series, Vol. VII.

[10] *Les méthodes nouvelles*, Vol. I, pp. 58–61.

except that it has been tacitly assumed that it does not take values which would introduce singularities in their right members. In particular, there is in general no reason why it may not be numerically equal to a, although the expansions are made with respect to a alone. The following is the use which will be made of the β: Suppose that in the differential equations a certain parameter μ occurs in two distinct ways; one, such that the right members may be expanded as power series in it in a simple manner; the other, such that the expansions are more difficult, or even impossible. When μ occurs in the first way it may be replaced by a, and when it appears in the second way by β. The solutions may be expanded as power series in a, and at the end a and β given their numerical values, which are equal. This artifice, which appears not to have been heretofore employed, is essential in the proof of the validity of many of the processes which have been employed in celestial mechanics with success without it having been demonstrated that they were valid; and, in constructing new series for solutions of differential equations, it opens up such a number of possibilities within the realm of validity that the chances of securing proved rigor and at the same time practicability are greatly increased. These remarks are illustrated in the applications which follow.

Instead of there being one parameter a, there may be any number, when the solutions will be multiple series. Corresponding theorems respecting the convergence hold.

§6. APPLICATION TO THE COMPUTATION OF THE ABSOLUTE PERTURBATIONS OF THE ELEMENTS

Suppose there are the sun, whose mass will be taken as unity, and two planets whose masses are m_1 and m_2. If the origin is taken at the center of the sun, the differential equations of motion in rectangular co-ordinates are:

$$
\left\{
\begin{aligned}
&\frac{dx_1}{dt} - x_1' = 0\,, \quad \frac{dx_1'}{dt} + k^2(1+m_1)\frac{x_1}{r_1^3} = m_2\frac{\partial R_1}{\partial x_1}\,,\\
&\frac{dy_1}{dt} - y_1' = 0\,, \quad \frac{dy_1'}{dt} + k^2(1+m_1)\frac{y_1}{r_1^3} = m_2\frac{\partial R_1}{\partial y_1}\,,\\
&\frac{dz_1}{dt} - z_1' = 0\,, \quad \frac{dz_1'}{dt} + k^2(1+m_1)\frac{z_1}{r_1^3} = m_2\frac{\partial R_1}{\partial z_1}\,,\\
&\frac{dx_2}{dt} - x_2' = 0\,, \quad \frac{dx_2'}{dt} + k^2(1+m_2)\frac{x_2}{r_2^3} = m_1\frac{\partial R_2}{\partial x_2}\,,\\
&\frac{dy_2}{dt} - y_2' = 0\,, \quad \frac{dy_2'}{dt} + k^2(1+m_2)\frac{y_2}{r_2^3} = m_1\frac{\partial R_2}{\partial y_2}\,,\\
&\frac{dz_2}{dt} - z_2' = 0\,, \quad \frac{dz_2'}{dt} + k^2(1+m_2)\frac{z_2}{r_2^3} = m_1\frac{\partial R_2}{\partial z_2}\,;\\
&R_1 = k^2\left[\frac{1}{r_{1,2}} - \frac{x_1x_2 + y_1y_2 + z_1z_2}{r_2^3}\right],\\
&R_2 = k^2\left[\frac{1}{r_{1,2}} - \frac{x_2x_1 + y_2y_1 + z_2z_1}{r_1^3}\right],
\end{aligned}
\right. \tag{28}
$$

where r_1 and r_2 are the distances from m_1 and m_2 to the sun and $r_{1,2}$ is the distance between m_1 and m_2.

When the right members are put equal to zero, the equations reduce to those for the problem of two bodies, and can be solved. Consequently the method of the variation of parameters can be employed as explained in §4. Suppose the elements of the orbit of m_1 are $a_1, a_2, \cdots, a_6$, and of m_2, $b_1, b_2, \cdots, b_6$. Then, after the method of the variation of parameters has been applied once, the differential equations will have the form

$$
\begin{aligned}
&\frac{da_i}{dt} = m_2\,\phi_i(a_1, \cdots, a_6, b_1, \cdots, b_6, t)\,, \qquad (i=1, \cdots, 6)\,,\\
&\frac{db_i}{dt} = m_1\,\psi_i(a_1, \cdots, a_6, b_1, \cdots, b_6, t)\,.
\end{aligned} \tag{29}
$$

The distribution of the parameters into a's and β's must be made before equations (29) are integrated. The parameters are m_1 and m_2, which appear in the right members as factors. The functions ϕ_i and ψ_i originally depended upon the co-ordinates $x_1, y_1, z_1, x_2, y_2, z_2$. These were eliminated by means of the solutions of (28) after the right members were put equal to zero; but, since the left members of (28) involve m_1 and m_2, the functions ϕ_i and ψ_i involve m_1 and m_2 implicitly. In order to simplify matters and to establish the validity of the ordinary expressions which are used in the theory of absolute perturbations, the m_1 and m_2 which occur as factors of ϕ_i and ψ_i respectively will be regarded as being a's and those which enter implicitly in ϕ_i and ψ_i as being β's. If this were not done, the ϕ_i and ψ_i would have to be expanded as power series in m_1 and m_2,[11] thus adding enormously to the labor of practically carrying out the work, while the expressions obtained would not be those used by astronomers.

The problem now is to integrate equations (29), which are as general as (28) and valid so long as the Jacobian of the equations of transformation does not vanish. In the mutual perturbations of the planets it never vanishes when the elements are conveniently defined. It is no more possible to obtain integrals of (29) in finite numbers of terms than it was in the case of (28), but it is possible to integrate them as power series in m_1 and m_2, which will, as was seen in § 5, absolutely converge so long as t is not too far from its initial value.

It will now be shown how the coefficients of the series can be computed, and that the various terms have obvious physical interpretations. The solutions are to have the forms[12]

$$\begin{aligned} a_i &= \sum_{j,k=0}^{\infty} a_i^{(j,k)}\, m_1^j m_2^k \qquad (i=1, \cdots, 6)\ , \\ b_i &= \sum_{j,k=0}^{\infty} b_i^{(j,k)}\, m_1^j m_2^k \end{aligned} \tag{30}$$

where the $a_i^{(j,k)}$ and the $b_i^{(j,k)}$ are functions of the time to be determined. It will be supposed that the terms are arranged so that the sum $j+k$ proceeds in the order of the natural numbers.

Substituting (30) in (29), it is found that

$$\begin{aligned}
&\frac{da_i^{(0,0)}}{dt} + \frac{da_i^{(0,1)}}{dt} m_2 + \frac{da_i^{(1,0)}}{dt} m_1 + \frac{da_i^{(1,1)}}{dt} m_1 m_2 + \frac{da_i^{(0,2)}}{dt} m_2^2 + \frac{da_i^{(2,0)}}{dt} m_1^2 + \cdots \\
&\qquad = m_2 \phi_i (a_1^{(0,0)}, \cdots, a_6^{(0,0)}, b_1^{(0,0)}, \cdots, b_6^{(0,0)}, t) + m_2 \sum_{j=1}^{6} \frac{\partial \phi_i}{\partial a_j} (a_j^{(0,1)} m_2 + a_j^{(1,0)} m_1) \\
&\qquad + m_2 \sum_{j=1}^{6} \frac{\partial \phi_i}{\partial b_j} (b_j^{(0,1)} m_2 + b_j^{(1,0)} m_1) + \text{higher powers in } m_1 \text{ and } m_2\ , \\
&\frac{db_i^{(0,0)}}{dt} + \frac{db_i^{(0,1)}}{dt} m_2 + \frac{db_i^{(1,0)}}{dt} m_1 + \frac{db_i^{(1,1)}}{dt} m_1 m_2 + \frac{db_i^{(0,2)}}{dt} m_2^2 + \frac{db_i^{(2,0)}}{dt} m_1^2 + \cdots \\
&\qquad = m_1 \psi_i (a_1^{(0,0)}, \cdots, a_6^{(0,0)}, b_1^{(0,0)}, \cdots, b_6^{(0,0)}, t) + m_1 \sum_{j=1}^{6} \frac{\partial \psi_i}{\partial a_j} (a_j^{(0,1)} m_2 + a_j^{(1,0)} m_1) \\
&\qquad + m_1 \sum_{j=1}^{6} \frac{\partial \psi_i}{\partial b_j} (b_j^{(0,1)} m_2 + b_j^{(1,0)} m_1) + \text{higher powers in } m_1 \text{ and } m_2\ .
\end{aligned} \tag{31}$$

Equating coefficients of corresponding powers of m_1 and m_2 in the right and left members of these equations, it is found that

[11] Compare POINCARÉ, *Méthodes nouvelles*, Vol. I, p. 270, where this expansion is used.

[12] Compare the "order of small quantity" method given by TISSERAND, *Mécanique céleste*, Vol. I, p. 194.

$$\frac{d a_i^{(0,0)}}{dt} = 0 , \qquad (i=1, \ldots, 6) ,$$
$$\frac{d b_i^{(0,0)}}{dt} = 0 , \tag{32}$$

$$\frac{d a_i^{(0,1)}}{dt} = \phi_i (a_1^{(0,0)}, \ldots, a_6^{(0,0)}, b_1^{(0,0)}, \ldots, b_6^{(0,0)}, t) \qquad (i=1, \ldots, 6) ,$$
$$\frac{d a_i^{(1,0)}}{dt} = 0 ,$$
$$\frac{d b_i^{(0,1)}}{dt} = 0 , \tag{33}$$
$$\frac{d b_i^{(1,0)}}{dt} = \psi_i (a_1^{(0,0)}, \ldots, a_6^{(0,0)}, b_1^{(0,0)}, \ldots, b_6^{(0,0)}, t) ,$$

$$\frac{d a_i^{(1,1)}}{dt} = \sum_{j=1}^{6} \frac{\partial \phi_i}{\partial a_j} a_j^{(1,0)} + \sum_{j=1}^{6} \frac{\partial \phi_i}{\partial b_j} b_j^{(1,0)} \qquad (i=1, \ldots, 6) ,$$
$$\frac{d a_i^{(0,2)}}{dt} = \sum_{j=1}^{6} \frac{\partial \phi_i}{\partial a_j} a_j^{(0,1)} + \sum_{j=1}^{6} \frac{\partial \phi_i}{\partial b_j} b_j^{(0,1)} ,$$
$$\frac{d a_i^{(2,0)}}{dt} = 0 ,$$
$$\frac{d b_i^{(1,1)}}{dt} = \sum_{j=1}^{6} \frac{\partial \psi_i}{\partial a_j} a_j^{(0,1)} + \sum_{j=1}^{6} \frac{\partial \psi_i}{\partial b_j} b_j^{(0,1)} , \tag{34}$$
$$\frac{d b_i^{(2,0)}}{dt} = \sum_{j=1}^{6} \frac{\partial \psi_i}{\partial a_j} a_j^{(1,0)} + \sum_{j=1}^{6} \frac{\partial \psi_i}{\partial b_j} b_j^{(1,0)} ,$$
$$\frac{d b_i^{(0,2)}}{dt} = 0 .$$

etc.

Integrating (32) and substituting the values of $a_i^{(0,0)}$ and $b_i^{(0,0)}$ thus obtained in (33), the latter are reduced to quadratures and can be integrated; integrating (33) and substituting the expressions for $a_i^{(0,1)}$, $a_i^{(1,0)}$, $b_i^{(0,1)}$, and $b_i^{(1,0)}$ in (34), the latter are reduced to quadratures and can be integrated; and this process may be repeated indefinitely, giving any desired number of coefficients of the series (30). When valid processes in performing the quadratures are employed, the elements are rigorously determined within certain time limits.[13]

An additive constant of integration is introduced with each integration which can be determined, as was shown in § 5, from the initial conditions. Suppose $a_i^{(j,k)} = f_i^{(j,k)}(t) - \alpha_i^{(j,k)}$, $b_i^{(j,k)} = g_i^{(j,k)}(t) - \beta_i^{(j,k)}$, where the $\alpha_i^{(j,k)}$ and $\beta_i^{(j,k)}$ are the constants of integration to be determined. Let the initial values of a_i and b_i be $a_i^{(0)}$ and $b_i^{(0)}$ respectively. Then equations (30) become at $t=0$

$$a_i^{(0)} = \sum_{j,k=0}^{\infty} [f_i^{(j,k)}(0) - \alpha_i^{(j,k)}] m_1^j m_2^k \qquad (i=1, \ldots, 6) ,$$
$$b_i^{(0)} = \sum_{j,k=0}^{\infty} [g_i^{(j,k)}(0) - \beta_i^{(j,k)}] m_1^j m_2^k . \tag{35}$$

[13] Compare the statement in DZIOBEK, *Planeten-Bewegungen*, p. 167.

Since the osculating elements are independent of the disturbing masses, these series are identities in m_1 and m_2, whence

$$
\left.
\begin{aligned}
&a_i^{(0,0)} = a_i^{(0)} \;, \\
&b_i^{(0,0)} = b_i^{(0)} \;, \\
&a_i^{(j,0)} = 0 && (j=1, \ldots, \infty) \;, \\
&b_i^{(0,k)} = 0 && (k=1, \ldots, \infty) \;, \\
&f_i^{(j,k)}(0) - a_i^{(j,k)} = 0 && (j=1, \ldots, \infty \;,\; k=1, \ldots, \infty) \;, \\
&g_i^{(j,k)}(0) - \beta_i^{(j,k)} = 0 && (j=1, \ldots, \infty \;,\; k=1, \ldots, \infty) \;.
\end{aligned}
\right\} \tag{36}
$$

The $a_i^{(0,0)}$ and $b_i^{(0,0)}$ are the osculating elements at the time $t=0$, and the perturbations of the first order with respect to the masses are given by (33), which, because of (36), reduce to

$$
\left.
\begin{aligned}
\frac{d a_i^{(0,1)}}{dt} &= \phi_i\left(a_1^{(0)}, \ldots, a_6^{(0)}, b_1^{(0)}, \ldots, b_6^{(0)}, t\right) \;, \\
\frac{d b_i^{(1,0)}}{dt} &= \psi_i\left(a_1^{(0)}, \ldots, a_6^{(0)}, b_1^{(0)}, \ldots, b_6^{(0)}, t\right) \;.
\end{aligned}
\right\} \tag{37}
$$

The right members of these equations are proportional to the rates at which the various elements of the orbits of the two planets would vary at the time t if the planets were moving at that instant in the original ellipses; the integrals are the summations of the changes which would be produced if the forces and their instantaneous effects were always exactly equal to those in the undisturbed orbits. Of course, the perturbations modify the expressions for the true rates at which the elements vary, but they are taken care of in terms of higher order.

Since the differential equations (29) involve the parameters m_1 and m_2 to the first degree only, they are valid for all finite values. Consequently this method of computing the absolute perturbations does not depend for its validity upon the fact that the masses of the planets are small compared to that of the sun. However, the smaller the masses of the planets are, the longer the time for which the series converge.

If there were a third planet, the elements a_i and b_i would have terms of the first order of the general type of the right members of (37) coming from its attraction, but the effects of each planet in the terms of the first order would be computed separately.

As a consequence of (36) and (37) the terms of the second order, given by (34), reduce to

$$
\left.
\begin{aligned}
\frac{d a_i^{(1,1)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i\left(a_1^{(0)}, \ldots, a_6^{(0)}, b_1^{(0)}, \ldots, b_6^{(0)}, t\right)}{\partial b_j^{(0)}}\, b_j^{(1,0)} && (i=1, \ldots, 6) \;, \\
\frac{d a_i^{(0,2)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i\left(a_1^{(0)}, \ldots, a_6^{(0)}, b_1^{(0)}, \ldots, b_6^{(0)}, t\right)}{\partial a_j^{(0)}}\, a_j^{(0,1)} \;, \\
\frac{d b_i^{(1,1)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \psi_i\left(a_1^{(0)}, \ldots, a_6^{(0)}, b_1^{(0)}, \ldots, b_6^{(0)}, t\right)}{\partial a_j^{(0)}}\, a_j^{(0,1)} \;, \\
\frac{d b_i^{(2,0)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \psi_i\left(a_1^{(0)}, \ldots, a_6^{(0)}, b_1^{(0)}, \ldots, b_6^{(0)}, t\right)}{\partial b_j^{(0)}}\, b_j^{(1,0)} \;.
\end{aligned}
\right\} \tag{38}
$$

The perturbations of the second order arise from the fact that both m_1 and m_2 depart from their original ellipses by terms of the first order. The perturbations of the second order of the elements of m_1, due to the fact that m_2 departs from its original orbit by terms of the first order, are given by equations of the type of the first of (38); for, if $b_j^{(1,0)}$, the first-order perturbations of m_2, were zero, $a_i^{(1,1)}$ would be zero also. Similarly, the perturbations of the second order of m_1, due to the fact that m_1 departs from its original ellipse by terms of the first order, are given by equations of the

type of the second of (38). The terms $b_i^{(1,1)}$ and $b_i^{(2,0)}$ in the elements of the orbit of m_2 arise from similar causes. Thus the terms of the second order correct the errors which would be committed by stopping with terms of the first order, and those of the third order correct those of the second, and so on indefinitely.

If there are three planets, the perturbations of the second order are considerably more complicated, the terms arising from the attractions of the various planets not appearing separately, as they do in case of the terms of the first order. Suppose the third planet is m_3 and that the elements of its orbit are $c_1, \cdots, c_6$. Then the differential equations which define the terms of the second order are

$$
\left\{
\begin{aligned}
\frac{da_i^{(1,1,0)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, b_1^{(0)}, \cdots, b_6^{(0)}, t)}{\partial b_j^{(0)}} b_j^{(1,0,0)} \qquad (i=1, \cdots, 6)\ , \\
\frac{da_i^{(1,0,1)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, c_1^{(0)}, \cdots, c_6^{(0)}, t)}{\partial c_j^{(0)}} c_j^{(1,0,0)}\ , \\
\frac{da_i^{(0,2,0)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, b_1^{(0)}, \cdots, b_6^{(0)}, t)}{\partial a_j^{(0)}} a_j^{(0,1,0)}\ , \\
\frac{da_i^{(0,0,2)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, c_1^{(0)}, \cdots, c_6^{(0)}, t)}{\partial a_j^{(0)}} a_j^{(0,0,1)}\ , \\
\frac{da_i^{(0,1,1)}}{dt} &= \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, b_1^{(0)}, \cdots, b_6^{(0)}, t)}{\partial a_j^{(0)}} a_j^{(0,0,1)}\ , \\
&+ \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, b_1^{(0)}, \cdots, b_6^{(0)}, t)}{\partial b_j^{(0)}} b_j^{(0,0,1)}\ , \\
&+ \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, c_1^{(0)}, \cdots, c_6^{(0)}, t)}{\partial a_j^{(0)}} a_j^{(0,1,0)}\ , \\
&+ \sum_{j=1}^{6} \frac{\partial \phi_i(a_1^{(0)}, \cdots, a_6^{(0)}, c_1^{(0)}, \cdots, c_6^{(0)}, t)}{\partial c_j^{(0)}} c_j^{(0,1,0)}\ ,
\end{aligned}
\right. \tag{39}
$$

and the corresponding equations for $\frac{db_i}{dt}$ and $\frac{dc_i}{dt}$.

Equations of the type of the first give the perturbations arising from the attraction of m_2 due to the fact that m_2 has been drawn from its original ellipse by m_1; the second, the perturbations arising from the attraction of m_3 due to the fact that m_3 has been drawn from its original ellipse by m_1; the third, the perturbations arising from the attraction of m_2 due to the fact that m_1 has been drawn from its original ellipse by m_2; the fourth, the perturbations arising from the attraction of m_3 due to the fact that m_1 has been drawn from its original ellipse by m_3; the first term of the fifth, the perturbations arising from the attraction of m_2 due to the fact that m_1 has been drawn from its original ellipse by m_3; the second term of the fifth, the perturbations arising from the attraction of m_2 due to the fact that m_2 has been drawn from its original ellipse by m_3; the third term of the fifth, the perturbations arising from the attraction of m_3 due to the fact that m_1 has been drawn from its original ellipse by m_2; and the fourth term of the fifth, the perturbations arising from the attraction of m_3 due to the fact that m_3 has been drawn from its original ellipse by m_2. Thus precisely those terms appear which would be expected from physical considerations.

Consider the general case in which there are n planets $m_1, \cdots, m_n$. The planet m_1, for example, suffers first-order perturbations due to the attraction of m_2. This deviation of m_1 from its elliptical orbit gives terms of the second order arising from the attraction of each of the remaining planets,

thus giving $n-1$ terms of the second order. Similar results arise from the first-order perturbations of m_1 by m_3, and so on down to the planet m_n. Since there are $n-1$ planets besides m_1, there are in all $(n-1)^2$ terms of the second order in the perturbations of every element of the orbit of m_1 due to the fact that it has deviated from its original orbit by terms of the first order. The elements of the orbit of m_2 have $n-1$ terms of the first order arising from the attraction of the remaining $n-1$ planets for it, and each of these gives rise to a term of the second order in the perturbations of the elements of the orbit of m_1, or $n-1$ new terms of the second order. This is true for each of the remaining planets, so that there are in all $(n-1)^2$ terms of the second order in the perturbations of every element of the orbit of m_1 due to the fact that $m_2, \cdots, m_n$ depart from their original ellipses by terms of the first order. Therefore each element of the orbit of m_1 has $2(n-1)^2$ different perturbations of the second order, and for the whole n planets there are $2n(n-1)^2$ terms of the second order. When there are two planets, there are four terms of the second order, given by equations (38). When there are three planets, there are twenty-four terms, the first eight of which are given in (39). When there are eight planets, as in the solar system, there are 784 terms of the second order for each of the six elements. Fortunately nearly all of them are so small as to be insensible.[14]

In order that the conclusions may be sound, the quadratures must be made by valid processes. In the case of the mutual perturbations of the great planets it can be shown that the series which are ordinarily employed in preparation for the quadratures are convergent.

§7. A VALID METHOD OF AVOIDING SECULAR TERMS OF THE FIRST ORDER

In the right members of the differential equations which define the perturbations of the first order with respect to the masses there are, in the expansions which are usually employed, terms of two types: (a) those in which the time is involved in the cosine or sine functions, and (b) those which are independent of the time. Upon integration the first type gives sine and cosine terms, which are consequently periodic and always finite; but the second type gives terms which change indefinitely with the time.[15] In the perturbations of the second order with respect to the masses there are, except in the case of the major axes, periodic terms, terms which contain the time and periodic terms as products, which will be called Poisson terms, terms containing the time to the first degree, and terms containing the time to the second degree. In perturbations of the third order with respect to the masses there are terms of the third degree in the time; etc.

Although terms appear which change indefinitely with the time, it does not in the least follow that the elements change indefinitely with the time. It may be that these so-called *secular terms* are the expansions of periodic terms, and, if so, it is desirable, at least for practical purposes, that the expanded forms be avoided. The question arises if this may not be done by modifying the method of integrating the differential equations. Whether it can be done or not, it *proves* nothing regarding the stability of the system, unless the series can be proved to be uniformly convergent; but this problem has not even been approached yet, much less solved.[16] Lagrange has succeeded in showing[17] by formal processes that the secular terms of the first order of the masses and of the first order in the eccentricities and mutual inclinations may be avoided entirely. Leverrier has shown[18] that when terms of the fourth order in the eccentricities and inclinations in the perturbative function are included, the solutions still retain the periodic form. Finally, Poincaré has shown[19] that the secular terms of all orders may formally be integrated in series which are periodic. He says, in

[14] The coefficients of the various powers of the masses are here spoken of as being "terms;" when carried out in practice, each is in reality a multiply infinite system of simple terms.

[15] There is the well-known exception in the case of the major axes.

[16] See BALL, *Story of the Heavens*, p. 351, where the generally accepted erroneous view regarding this matter is advanced.

[17] *Collected Works*, Vols. V and VI.

[18] *Annales de l'observatoire de Paris*, Vol. II, Addition III.

[19] *Les méthodes nouvelles de la mécanique céleste*, Vol. II, chap. i.

conclusion,[20] that Lagrange and Laplace would have regarded this as completely establishing the stability of the solar system, but that it is not sufficient now because of the lack of proof of convergence of the series.

The question arises how far the method of Lagrange leads to significant results, for the assumptions and approximations may be such that the conclusions may be erroneous, especially when long intervals of time are involved.[21] In a general way this is the subject of the present inquiry, and it will be shown that results which are, from a practical point of view, sensibly the same, though not quite, may be obtained by processes which have been proved to be valid for not too long a time.

Let the elements of the orbit of the planet m_j be a_j, e_j, $\tilde{\omega}_j$, ϵ_j, Ω_j, and i_j, where the letters have the usual significations. Then let the variables h_j, l_j, p_j, and q_j be defined by the equations

$$\begin{aligned} h_j &= e_j \sin \tilde{\omega}_j \qquad (j=1, \dots, n) \ , \\ l_j &= e_j \cos \tilde{\omega}_j \ , \\ p_j &= \tan i_j \sin \Omega_j \ , \\ q_j &= \tan i_j \cos \Omega_j \ . \end{aligned} \tag{40}$$

Then the differential equations become

$$\begin{aligned} \frac{da_j}{dt} &= f_j(a_k, \epsilon_k, h_k, l_k, p_k, q_k, t) \qquad (j=1, \dots, n) \ , \ (k=1, \dots, n) \ , \\ \frac{d\epsilon_j}{dt} &= g_j(a_k, \epsilon_k, h_k, l_k, p_k, q_k, t) \ , \\ \frac{dh_j}{dt} &= \theta_j(a_k, \epsilon_k, h_k, l_k, p_k, q_k, t) \ , \\ \frac{dl_j}{dt} &= \phi_j(a_k, \epsilon_k, h_k, l_k, p_k, q_k, t) \ , \\ \frac{dp_j}{dt} &= \psi_j(a_k, \epsilon_k, h_k, l_k, p_k, q_k, t) \ , \\ \frac{dq_j}{dt} &= \chi_j(a_k, \epsilon_k, h_k, l_k, p_k, q_k, t) \ . \end{aligned} \tag{41}$$

The perturbative functions for the various pairs of planets, upon which the right members of equations (41) depend, have the form[22]

$$R_{j,k} = \sum M e_j^H e_k^{H'} \left(\tan\frac{i_j}{2}\right)^G \left(\tan\frac{i_k}{2}\right)^{G'} \cos(\alpha l_j + \alpha' l_k + \beta\tilde{\omega}_j + \beta'\tilde{\omega}_k + \gamma\Omega_j + \gamma'\Omega_k) \ , \tag{42}$$

where $l_j = n_j t - \epsilon_j$, n_j being the mean motion of m_j. The summation extends over all integral values of α, α', β, β', γ, γ', and H, H', G, and G' are respectively equal to the numerical values of $\beta, \beta', \gamma, \gamma'$ increased by zero or positive integers, and M are functions of a_j and a_k. Now, $\tan\frac{i}{2}$ is related to $\tan i$ by the equation

$$\tan i = \frac{2\tan\frac{i}{2}}{1-\tan^2\frac{i}{2}} \ ,$$

from which it easily follows that $\tan\frac{i}{2}$ is expressible as an infinite series of odd powers of $\tan i$. Therefore $\left(\tan\frac{i_j}{2}\right)^G$ is expressible as an infinite series in $\tan i$, with even or odd exponents according

[20] *Loc cit.*, p. 46.

[21] See DZIOBEK, *Planeten-Bewegungen*, p. 275; TISSERAND *Mécanique céleste*, Vol. I, p. 429.

[22] See TISSERAND, *Mécanique céleste*, Vol. I, p. 317.

as G is even or odd, and (42) may be written

$$R_{j,k} = \sum M e_j^H e_k^{H'} (\tan i_j)^K (\tan i_k)^{K'} \cos (\alpha l_j + \alpha' l_k + \beta \tilde{\omega}_j + \beta' \tilde{\omega}_k + \gamma \Omega_j + \gamma' \Omega_k) \;, \tag{43}$$

where K and K' equal the numerical values of γ and γ' plus zero or positive integers.

It is known that $\cos \nu x$ and $\sin \nu x$ are expressible as sums of powers of $\cos x$ and $\sin x$ respectively, where the highest power is ν and the various powers are all even or odd according as ν is even or odd. Consequently it follows from the relations of the exponents H, H', K, and K' to the coefficients β, β', γ, and γ', and from the equations $e_j^2 = h_j^2 + l_j^2$ and $\tan^2 i_j = p_j^2 + q_j^2$, that $R_{j,k}$ is expressible as a power series in h_j, h_k, l_j, l_k, p_j, p_k, q_j, q_k; and these series converge for the values of the arguments that occur in the case of the mutual perturbations of the major planets. Therefore the right members of equations (41) are linear in the mass factors m_k $(k=1, \cdots, j-1, j+1, \cdots, n)$, and, since the coefficients of the partial derivatives of the perturbative function are expansible as series in h_j, h_k, $\cdots$, q_j, q_k, they are power series in h_j, h_k, $\cdots$, q_j, q_k with the a_k entering in the M's and the ϵ_k entering only under the trigonometric functions.

The secular terms are those in which every α, α' occurring in the perturbative functions (43) is zero. It should be remarked here that others would occur if the mean motions of any two of the planets were commensurable, but as there are in every case within the limits of accuracy of the observations an infinite number of incommensurable as well as commensurable ratios, it is always assumed that the mean motions are incommensurable. There are no secular terms in the case of the element a_j for $\alpha = \alpha' = 0$, but this element would have secular terms if the mean motions were commensurable.

Lagrange treated the equations (41) by taking out the secular terms in the case of the last four variables, neglecting all except their first powers, and, assuming the a_j to be constant, he integrated the resulting linear homogeneous system whose coefficients were by assumption constants. He found the solutions and showed that they are all periodic functions of the time. The periodic parts of (41) which remained were integrated by quadratures by considering the elements as constants in the right members. It is perfectly clear that this method, which leads to the only existing theoretical conclusions regarding the stability of the solar system—to the so-called Magna Charta of the permanence of the solar system in its present form—contains a number of assumptions of a very radical type, and that it leads to no such general conclusions as have been drawn from it. Nevertheless, it undoubtedly represents quite approximately the actual changes which the system will undergo for a very long time. The method which is about to be explained gives much the same terms and is proved to be perfectly valid for a positive finite time.

Suppose the secular and periodic parts of the right members of (41) are written separately. Then let the mass factors m_k which occur as coefficients of the secular terms be replaced by $\frac{m_k'}{\mu}$, but remain unchanged in the case of the periodic terms. In the final results m_k' is to be given the numerical value of m_k and μ is to be put equal to unity. Let h_k, l_k, p_k, and q_k everywhere in the secular terms be replaced by μh_k, μl_k, μp_k, μq_k. Then the right members of (41) will be composed of two parts. One part will not involve the time explicitly and will be power series in μ, beginning with a term which is independent of this parameter. The other part will involve the time under the cosine and sine functions, and will be linear and homogeneous in the parameters $m_1, \cdots, m_n$. The first part gives rise to the so-called secular terms and the second part to the periodic and long-period terms. The secular terms do not appear in the case of the elements a_j, but are present in the right members of all the other elements.

The differential equations will now be integrated as power series in μ and $m_1, \cdots, m_n$. In order to simplify the details, suppose there are but two planets, m_1 and m_2, and to abbreviate the notation let

$$\begin{aligned} h_1 &= x_1 \,, & l_1 &= x_2 \,, & h_2 &= x_3 \,, & l_2 &= x_4 \,, \\ p_1 &= y_1 \,, & q_1 &= y_2 \,, & p_2 &= y_3 \,, & q_2 &= y_4 \,. \end{aligned} \tag{44}$$

Then the differential equations become

$$
\left.
\begin{aligned}
\frac{da_1}{dt} &= m_2 f_1(a_1, a_2, \epsilon_1, \epsilon_2, x_i, y_i, t) \qquad (i=1,2,3,4) ,\\
\frac{d\epsilon_1}{dt} &= \sum_{j=0}^{\infty} g_{1j}(a_1, a_2, x_i, y_i)\,\mu^j + m_2 g_{01}(a_1, a_2) + m_2 g_1(a_1, a_2, \epsilon_1, \epsilon_2, x_i, y_i, t) ,\\
\frac{dx_k}{dt} &= \sum_{j=0}^{\infty} \phi_{1kj}(a_1, a_2, x_i, y_i)\,\mu^j + m_2 \phi_{1k}(a_1, a_2, \epsilon_1, \epsilon_2, x_i, y_i, t) \qquad (k=1,2,3,4) ,\\
\frac{da_2}{dt} &= m_1 f_2(a_1, a_2, \epsilon_1, \epsilon_2, x_i, y_i, t) ,\\
\frac{d\epsilon_2}{dt} &= \sum_{j=0}^{\infty} g_{2j}(a_1, a_2, x_i, y_i)\,\mu^j + m_1 g_{02}(a_1, a_2) + m_1 g_2(a_1, a_2, \epsilon_1, \epsilon_2, x_i, y_i, t) ,\\
\frac{dy_k}{dt} &= \sum_{j=0}^{\infty} \phi_{2kj}(a_1, a_2, x_i, y_i)\,\mu^j + m_1 \phi_{2k}(a_1, a_2, \epsilon_1, \epsilon_2, x_i, y_i, t) .
\end{aligned}
\right\} \tag{45}
$$

The functions ϕ_{1kj} and ϕ_{2kj} are homogeneous in x_i and y_i of degree $j+1$.

The solutions are to have the form

$$
\left.
\begin{aligned}
a_i &= \sum_{j,j_1,j_2=0}^{\infty} a_i^{(j,j_1,j_2)}\,\mu^j m_1^{j_1} m_2^{j_2} \qquad (i=1,2) ,\\
\epsilon_i &= \sum_{j,j_1,j_2=0}^{\infty} \epsilon_i^{(j,j_1,j_2)}\,\mu^j m_1^{j_1} m_2^{j_2} \qquad (i=1,2) ,\\
x_i &= \sum_{j,j_1,j_2=0}^{\infty} x_i^{(j,j_1,j_2)}\,\mu^j m_1^{j_1} m_2^{j_2} \qquad (i=1,2,3,4) ,\\
y_i &= \sum_{j,j_1,j_2=0}^{\infty} y_i^{(j,j_1,j_2)}\,\mu^j m_1^{j_1} m_2^{j_2} \qquad (i=1,2,3,4) ,
\end{aligned}
\right\} \tag{46}
$$

where the $a_i^{(j,j_1,j_2)}$, $\epsilon_i^{(j,j_1,j_2)}$, $x_i^{(j,j_1,j_2)}$, and $y_i^{(j,j_1,j_2)}$ are functions of the time to be determined. Substituting these expressions in (45), developing the right members, and equating corresponding powers of $\mu m_1 m_2$, it is found that

$$
\left.
\begin{aligned}
\frac{da_1^{(0,0,0)}}{dt} &= 0 ,\\
\frac{d\epsilon_1^{(0,0,0)}}{dt} &= g_{10}(a_1^{(0,0,0)}, a_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) \qquad (i=1,2,3,4) ,\\
\frac{dx_k^{(0,0,0)}}{dt} &= \phi_{1k0}(a_1^{(0,0,0)}, a_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) \qquad (k=1,2,3,4) ,\\
\frac{da_2^{(0,0,0)}}{dt} &= 0 ,\\
\frac{d\epsilon_2^{(0,0,0)}}{dt} &= g_{20}(a_1^{(0,0,0)}, a_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) ,\\
\frac{dy_k^{(0,0,0)}}{dt} &= \phi_{2k0}(a_1^{(0,0,0)}, a_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) ;
\end{aligned}
\right\} \tag{47}
$$

$$
\begin{aligned}
\frac{d\alpha_1^{(1,0,0)}}{dt} &= 0 , \\
\frac{d\epsilon_1^{(1,0,0)}}{dt} &= \frac{\partial g_{10}}{\partial \alpha_1}\alpha_1^{(1,0,0)} + \frac{\partial g_{10}}{\partial \alpha_2}\alpha_2^{(1,0,0)} + \sum_{i=1}^{4}\left[\frac{\partial g_{10}}{\partial x_i}x_i^{(1,0,0)} + \frac{\partial g_{10}}{\partial y_i}y_i^{(1,0,0)}\right] + g_{11}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) , \\
\frac{dx_k^{(1,0,0)}}{dt} &= \frac{\partial \phi_{1k0}}{\partial \alpha_1}\alpha_1^{(1,0,0)} + \frac{\partial \phi_{1k0}}{\partial \alpha_2}\alpha_2^{(1,0,0)} + \sum_{i=0}^{4}\left[\frac{\partial \phi_{1k0}}{\partial x_i}x_i^{(1,0,0)} + \frac{\partial \phi_{1k0}}{\partial y_i}y_i^{(1,0,0)}\right] \\
&\qquad + \phi_{1k1}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) , \\
\frac{d\alpha_2^{(1,0,0)}}{dt} &= 0 , \\
\frac{d\epsilon_2^{(1,0,0)}}{dt} &= \frac{\partial g_{20}}{\partial \alpha_1}\alpha_1^{(1,0,0)} + \frac{\partial g_{20}}{\partial \alpha_2}\alpha_2^{(1,0,0)} + \sum_{i=1}^{4}\left[\frac{\partial g_{20}}{\partial x_i}x_i^{(1,0,0)} + \frac{\partial g_{20}}{\partial y_i}y_i^{(1,0,0)}\right] + g_{21}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) , \\
\frac{dy_k^{(1,0,0)}}{dt} &= \frac{\partial \phi_{2k0}}{\partial \alpha_1}\alpha_1^{(1,0,0)} + \frac{\partial \phi_{2k0}}{\partial \alpha_2}\alpha_2^{(1,0,0)} + \sum_{i=1}^{4}\left[\frac{\partial \phi_{2k0}}{\partial x_i}x_i^{(1,0,0)} + \frac{\partial \phi_{2k0}}{\partial y_i}y_i^{(1,0,0)}\right] \\
&\qquad + \phi_{2k1}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}) ;
\end{aligned}
\tag{48}
$$

$$
\begin{aligned}
\frac{d\alpha_1^{(0,1,0)}}{dt} &= 0 , \\
\frac{d\epsilon_1^{(0,1,0)}}{dt} &= \frac{\partial g_{10}}{\partial \alpha_1}\alpha_1^{(0,1,0)} + \frac{\partial g_{10}}{\partial \alpha_2}\alpha_2^{(0,1,0)} + \sum_{i=1}^{4}\left[\frac{\partial g_{10}}{\partial x_i}x_i^{(0,1,0)} + \frac{\partial g_{10}}{\partial y_i}y_i^{(0,1,1)}\right] , \\
\frac{dx_k^{(0,1,0)}}{dt} &= \frac{\partial \phi_{1k0}}{\partial \alpha_1}\alpha_1^{(0,1,0)} + \frac{\partial \phi_{1k0}}{\partial \alpha_2}\alpha_2^{(0,1,0)} + \sum_{i=1}^{4}\left[\frac{\partial \phi_{1k0}}{\partial x_i}x_i^{(0,1,0)} + \frac{\partial \phi_{1k0}}{\partial y_i}y_i^{(0,1,0)}\right] , \\
\frac{d\alpha_2^{(0,1,0)}}{dt} &= f_2(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, \epsilon_1^{(0,0,0)}, \epsilon_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}, t) , \\
\frac{d\epsilon_2^{(0,1,0)}}{dt} &= \frac{\partial g_{20}}{\partial \alpha_1}\alpha_1^{(0,1,0)} + \frac{\partial g_{20}}{\partial \alpha_2}\alpha_2^{(0,1,0)} + \sum_{i=1}^{4}\left[\frac{\partial g_{20}}{\partial x_i}x_i^{(0,1,0)} + \frac{\partial g_{20}}{\partial y_i}y_i^{(0,1,0)}\right] \\
&\qquad + g_{02}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}) + g_2(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, \epsilon_1^{(0,0,0)}, \epsilon_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}, t) , \\
\frac{dy_k^{(0,1,0)}}{dt} &= \frac{\partial \phi_{2k0}}{\partial \alpha_1}\alpha_1^{(0,1,0)} + \frac{\partial \phi_{2k0}}{\partial \alpha_2}\alpha_2^{(0,1,0)} + \sum_{i=1}^{4}\left[\frac{\partial \phi_{2k0}}{\partial x_i}x_i^{(0,1,0)} + \frac{\partial \phi_{2k0}}{\partial y_i}y_i^{(0,1,0)}\right] \\
&\qquad + \phi_{2k}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, \epsilon_1^{(0,0,0)}, \epsilon_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}, t) ;
\end{aligned}
\tag{49}
$$

$$
\begin{aligned}
\frac{d\alpha_1^{(0,0,1)}}{dt} &= f_1(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, \epsilon_1^{(0,0,0)}, \epsilon_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}, t) , \\
\frac{d\epsilon_1^{(0,0,1)}}{dt} &= \frac{\partial g_{10}}{\partial \alpha_1}\alpha_1^{(0,0,1)} + \frac{\partial g_{10}}{\partial \alpha_2}\alpha_2^{(0,0,1)} + \sum_{i=1}^{4}\left[\frac{\partial g_{10}}{\partial x_i}x_i^{(0,0,1)} + \frac{\partial g_{10}}{\partial y_i}y_i^{(0,0,1)}\right] \\
&\qquad + g_{01}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}) + g_1(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, \epsilon_1^{(0,0,0)}, \epsilon_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}, t) , \\
\frac{dx_k^{(0,0,1)}}{dt} &= \frac{\partial \phi_{1k0}}{\partial \alpha_1}\alpha_1^{(0,0,1)} + \frac{\partial \phi_{1k0}}{\partial \alpha_2}\alpha_2^{(0,0,1)} + \sum_{i=1}^{4}\left[\frac{\partial \phi_{1k0}}{\partial x_i}x_i^{(0,0,1)} + \frac{\partial \phi_{1k0}}{\partial y_i}y_i^{(0,0,1)}\right] \\
&\qquad + \phi_{1k}(\alpha_1^{(0,0,0)}, \alpha_2^{(0,0,0)}, \epsilon_1^{(0,0,0)}, \epsilon_2^{(0,0,0)}, x_i^{(0,0,0)}, y_i^{(0,0,0)}, t) , \\
\frac{d\alpha_2^{(0,0,1)}}{dt} &= 0 , \\
\frac{d\epsilon_2^{(0,0,1)}}{dt} &= \frac{\partial g_{20}}{\partial \alpha_1}\alpha_1^{(0,0,1)} + \frac{\partial g_{20}}{\partial \alpha_2}\alpha_2^{(0,0,1)} + \sum_{i=1}^{4}\left[\frac{\partial g_{20}}{\partial x_i}x_i^{(0,0,1)} + \frac{\partial g_{20}}{\partial y_i}y_i^{(0,0,1)}\right] , \\
\frac{dy_k^{(0,0,1)}}{dt} &= \frac{\partial \phi_{2k0}}{\partial \alpha_1}\alpha_1^{(0,0,1)} + \frac{\partial \phi_{2k0}}{\partial \alpha_2}\alpha_2^{(0,0,1)} + \sum_{i=1}^{4}\left[\frac{\partial \phi_{2k0}}{\partial x_i}x_i^{(0,0,1)} + \frac{\partial \phi_{2k0}}{d y_i}y_i^{(0,0,1)}\right] ; \text{ etc.}
\end{aligned}
\tag{50}
$$

The proof that the expansions lead to the precise terms written depends upon the form of the perturbative function when expressed in these variables, and it will be assumed here that it is known.

Consider the integration of equations (47), (48), (49), and (50). From the first and fourth equations of (47) it follows that $a_1^{(0,0,0)}$ and $a_2^{(0,0,0)}$ are constants, and from the principles of § 5 that they are the values of these variables at $t=0$. It follows from the form of the secular part of the perturbative function that ϵ_1 and ϵ_2 are not involved explicitly in the right members of equations (47). Next consider the integration of the third and sixth systems of (47). They are linear with constant coefficients, and their integration presents no difficulties. The detailed discussion[23] shows that all of the roots of the characteristic equation are pure imaginaries with very small moduli. Consequently the $x_i^{(0,0,0)}$ and the $y_i^{(0,0,0)}$ are purely periodic with very long periods. These terms are precisely the ones found by Lagrange in his discussion of the secular variations.

Suppose the expressions for the $x_i^{(0,0,0)}$ and the $y_i^{(0,0,0)}$ are substituted in the right members of the second and fifth equations. They are reduced to quadratures and can be at once integrated, giving both secular and periodic terms for $\epsilon_1^{(0,0,0)}$ and $\epsilon_2^{(0,0,0)}$. But ϵ_1 and ϵ_2 occur only in the combinations $n_1 t + \epsilon_1$ and $n_2 t + \epsilon$, where n_1 and n_2 are the mean motions of the planets m_1 and m_2; therefore the secular terms in this element will produce no secular terms in the higher terms of the other elements.

Consider equations (48). It follows first that $a_1^{(1,0,0)}$ and $a_2^{(1,0,0)}$ are constants, and from the principles of § 5 that they are zero. The $x_k^{(1,0,0)}$ and $y_k^{(1,0,0)}$ are defined by linear non-homogeneous differential equations. The periods of the complementary functions, which are defined by the coefficients of the homogeneous parts, are the same as those of $x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$. The functions ϕ_{1k1} and ϕ_{2k1} are homogeneous of the second degree in $x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$. Therefore $x_i^{(1,0,0)}$ and $y_i^{(1,0,0)}$ will be purely periodic. The expressions for $\epsilon_1^{(1,0,0)}$ and $\epsilon_2^{(1,0,0)}$ are reduced to quadratures and contain purely periodic and secular terms.

Consider the integration of equations (49). In the first place, $a_1^{(0,1,0)}$ is a constant which must be zero according to the principles developed in § 5.

The right member of the fourth equation, which defines $a_2^{(0,1,0)}$, is periodic, the time being involved in the form

$$\sin\left[i_1(n_1 t+\epsilon_1)+i_2(n_2 t+\epsilon_2)\right] , \tag{51}$$

where i_1 and i_2 are integers and n_1 and n_2 the undisturbed mean motions of the two planets. The time is also involved through $\epsilon_1^{(0,0,0)}$ and $\epsilon_2^{(0,0,0)}$, each of which contains a secular term and series of periodic terms, as has just been seen, and through the $x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$ which enter in the coefficients of the sine functions. As has been shown, these variables are periodic with very long periods. Suppose the $x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$ are replaced by their trigonometric expressions, and let the powers of the cosines and sines be reduced to cosines and sines of multiples of the angles. These trigonometric functions will be multiplied by those of the type (51). Suppose the products are reduced to cosines and sines of the sums and differences. The final result will be purely periodic, unless the coefficients of t in some term derived from the $x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$ has the same numerical value as the coefficient of t in some term of the type (51). But the coefficients are very unequal in all the terms which have coefficients of sensible magnitude, and it would require particular values of the masses and the osculating a_i's that this condition should be fulfilled for any term whatever. If it were fulfilled, a slightly different epoch could be taken, so that it would not be exactly fulfilled. Since the osculating elements cannot be exactly determined, it may always be supposed that the coefficients will in no case be numerically equal. This is somewhat similar to the assumption that there are no secular terms in the case of the element a in the ordinary method of treatment. It follows from this that $a_2^{(0,1,0)}$ involves the time only under the cosine or sine function.

The equations which define the $x_k^{(0,1,0)}$ and $y_k^{(0,1,0)}$ are linear and non-homogeneous. The first

[23] See TISSERAND, *Mécanique céleste*, Vol. I, chap. xxiv.

terms of the right members are purely periodic, the same as in the case of the right member of the fourth equation. The complementary functions are the same, except for the constants of integration, as in the expressions for $x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$. The particular integrals will be composed of terms of the same periods as those which appear in the first two terms in the right members. The complete integrals are the sums of the complementary functions and the particular integrals. The constants of integration are determined by the conditions that the $x_i^{(0,1,0)}$ and $y_i^{(0,1,0)}$ shall all vanish at $t=0$.

Substituting the expressions for $a_1^{(0,1,0)}$, $x_i^{(0,1,0)}$, $a_2^{(0,1,0)}$, and $y_i^{(0,1,0)}$ in the right members of the second and fifth equations, they are reduced to quadratures and can be at once integrated, giving both periodic and secular terms for $\epsilon_1^{(0,1,0)}$ and $\epsilon_2^{(0,1,0)}$.

Equations (50) can be treated in a precisely similar manner, since they differ from (49) only by a permutation of the indices 1 and 2. If there are more than two planets, the right members of equations (49) and (50) contain more functions of the same type, one coming from each planet, and there is a set of equations similar to (49) and (50) for each planet.

The terms of the second order are the coefficients of μ^2, μm_1, μm_2, m_1^2, $m_1 m_2$, and m_2^2. It is possible to determine the character of these terms without writing out explicitly the differential equations by which they are defined. It will be convenient to have the results already attained stated together for reference.

$a_1^{(0,0,0)}$ and $a_2^{(0,0,0)}$ are constants, the values of the major semi-axes at $t=0$.

$x_i^{(0,0,0)}$ and $y_i^{(0,0,0)}$ are purely periodic, with very long periods.

$\epsilon_1^{(0,0,0)}$ and $\epsilon_2^{(0,0,0)}$ contain both periodic and secular terms.

$a_1^{(1,0,0)}$ and $a_2^{(1,0,0)}$ are zero.

$x_i^{(1,0,0)}$ and $y_i^{(1,0,0)}$ contain only periodic terms.

$\epsilon_1^{(1,0,0)}$ and $\epsilon_2^{(1,0,0)}$ contain periodic and secular terms.

$a_1^{(0,1,0)}$ is zero.

$a_2^{(0,1,0)}$ contains only purely periodic terms.

$x_i^{(0,1,0)}$ and $y_i^{(0,1,0)}$ contain only periodic terms of two types, short-period terms and very long-period terms.

$\epsilon_1^{(0,1,0)}$ and $\epsilon_2^{(0,1,0)}$ contain both purely periodic and secular terms.

$a_1^{(0,0,1)}$ contains only purely periodic terms.

$a_2^{(0,0,1)}$ is zero.

$x_i^{(0,0,1)}$ and $y_i^{(0,0,1)}$ contain only periodic terms of two types, short-period terms and very long-period terms.

$\epsilon_1^{(0,0,1)}$ and $\epsilon_2^{(0,0,1)}$ contain both purely periodic and secular terms.

Consider the coefficients of μ^2. It follows from (45), and the fact that all these coefficients must vanish at $t=0$, that $a_1^{(2,0,0)} = a_2^{(2,0,0)} = 0$. The $x_i^{(2,0,0)}$ and $y_i^{(2,0,0)}$ are defined by linear non-homogeneous differential equations. The non-homogeneous parts contain periodic terms, some of whose periods are the same as in the complementary functions. Consequently the $x_i^{(2,0,0)}$ and $y_i^{(2,0,0)}$ contain purely periodic and Poisson terms, and $\epsilon_1^{(2,0,0)}$ and $\epsilon_2^{(2,0,0)}$ contain periodic, Poisson, and secular terms. The character of the coefficients of the other terms of the second order can be determined in the same manner. It would be of no value to write them out here.

The results which have been obtained are as follows: The major axes have no secular or Poisson terms of the first order, and the periodic terms are all of short period, except the usual long-period terms. The x_i and y_i of order zero and one contain only purely periodic terms. The terms of order zero are precisely the very long-period terms found by Lagrange. The periodic terms of the first order are of two classes, the very long-period terms and the short-period terms. The latter are not precisely those found in Lagrange's theory, for their periods have been modified a very little by the very long-period terms. If the Lagrangian method is valid at all, its realm of validity is almost certainly much more restricted than that of this method. The short-period terms in the Lagrangian

method are computed with the osculating elements in the right members. Suppose now the lines of nodes and lines of apsides actually rotate as the terms of order zero indicate. The result will be that when half revolutions have been performed the Lagrangian short-period terms will be precisely opposite to what they should be, and it is very doubtful whether the whole process converges for such a time. On the other hand, the slight corrections to the periods introduced by the methods given here exactly take into account the effects of these rotations, so that the short-period terms are nearly correct for very long intervals of time. For short intervals of time the two methods give sensibly the same results up to the terms of the second order. That it is not necessary to take into account the relations of the nodes and apsides for practical purposes follows only from the fact that the motions are so slow that they do not affect the perturbations sensibly for a long time. However, in the case of the moon, where the corresponding motions are very rapid, they have been included by nearly every lunar theorist.[24] The case is not fundamentally different from this, although the artifices employed to accomplish the results are entirely distinct. Thus this method leads to terms of the same form as found by Lagrange, it is proved to be valid for a positive finite interval of time, and the period for which it is valid is probably much longer than that of the method of Lagrange, if, indeed, it is possible to make the latter the first step in a general process which converges for any value of the time.

It is seen that the Poisson and secular terms appear in the terms of higher order, so that even the form of the solutions does not apparently indicate stability. The conclusion is certain that there are at present no mathematical proofs of the permanent stability of the solar system, although the results given here prove that the present general configurations will be changed very slowly, if at all. The problem awaits further perfection of mathematics, and the fact that the initial conditions cannot be exactly determined may perhaps render the problem of stability forever incapable of solution, just as it is impossible to decide whether the major axes have secular terms of the first order, because it cannot be determined whether the mean motions are exactly commensurable or not.

§ 8. THE METHOD OF SMALL VARIATIONS

Suppose the solutions of a system of differential equations can be found for particular initial conditions. Then, if the actual initial conditions differ only a little from the particular ones, the actual co-ordinates will differ only a little from those given by the first solution, at least for a time. The method of finding the deviations from solutions defined by particular initial conditions will be termed, for convenience, the method of small deviations. It remains to be shown that under certain conditions these small deviations can be represented by convergent power series within certain time limits.

Suppose the differential equations to be solved are

$$\frac{dx_i}{dt} = X_i(x_1, \cdots, x_n, t) \qquad (i=1, \cdots, n) \; . \tag{52}$$

Suppose it is known in some way that for $x_i = x_i^{(0)}$ as initial conditions the solutions of (52) are

$$x_i = f_i(t) \qquad (i=1, \cdots, n) \; , \tag{53}$$

which will be supposed to be valid for all t equal to or greater than zero and less than T. Suppose the actual initial values of the co-ordinates are $x_i^{(0)} + \epsilon a_i$, where the a_i are small and ϵ is a parameter which is to be put equal to unity in the final results. Let the values of the co-ordinates under these conditions be

$$x_i = f_i(t) + \epsilon \xi_i \tag{54}$$

[24] See BROWN, *Lunar Theory*, p. 52.

where the ξ_i are the corrections to be determined. Substitute (54) in (52) and expand in powers of ξ_j, and it will be found that

$$\epsilon \frac{d\xi_i}{dt} = \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} \epsilon \xi_j + \text{higher powers in } \epsilon \xi_j \tag{55}$$

whose coefficients depend on the partial derivatives of X_i with respect to x_j. Suppose that for $\xi_j = a_j$ the right members of (55) converge for $0 \leqq t < T$.

Consider the integration of equations (55) as power series in the parameter ϵ. These equations fulfil all the conditions imposed upon those treated in § 5; consequently the solutions may be represented by series of the form

$$\xi_i = \sum_{j=0}^{\infty} \xi_i^{(j)} \epsilon^j , \tag{56}$$

where $\xi_i^{(j)}$ are functions of t, and where the series (56) converge for all $0 \leqq t < t_0$, where t_0 is a positive number. In general, the smaller the differences between the particular initial conditions giving the solutions (53) and the actual initial conditions, the larger is the value of t_0.

Suppose the solutions (53) are periodic and valid for all finite values of the time. Then the equations determining the deviations of the first order from the periodic solution are

$$\frac{d\xi_i^{(0)}}{dt} = \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_j} \xi_j^{(0)} \qquad (i=1, \cdots, n) , \tag{57}$$

where the coefficients of this linear homogeneous system are periodic functions. The solutions of this system will be periodic with the period depending on the coefficients and period of $\frac{\partial X_i}{\partial x_j}$. If these partial derivatives contain a constant term, as they do in most practical problems, and if the coefficients of the periodic terms involve powers of a small parameter m, then the period of the solutions of (57) will differ from that which would be obtained by neglecting the periodic terms by powers of m.

The deviations of the second order are determined by the equations

$$\frac{d\xi_i^{(1)}}{dt} = \sum_{j=1}^{n} \frac{\partial X_i}{\partial x_i} \xi_j^{(1)} + \frac{1}{2} \sum_{j=1}^{n} \sum_{j=1}^{n} \frac{\partial^2 X_i}{\partial x_j \partial x_k} \xi_j^{(0)} \xi_k^{(0)} . \tag{58}$$

which are linear, but not homogeneous. If any second term in the right member contains an expression of the same period as the $\xi_j^{(1)}$ would have without the non-linear part, then the solutions for $\xi_i^{(1)}$ will contain Poisson terms; otherwise the $\xi_i^{(1)}$ will be periodic. If Poisson terms enter in the $\xi_i^{(1)}$, then the $\xi_i^{(2)}$ will, in general, contain secular terms and terms of the type $c_1 t^2 \begin{smallmatrix}\sin\\ \cos\end{smallmatrix} (c_2 t + c_3)$. The higher terms will, in general, contain secular terms of higher degree and Poisson terms containing higher powers of t in their coefficients. Although this method gives rise to such terms, it neither shows that it is not valid nor that the motion under consideration is unstable; all that can be said is that it is valid if the time interval is not taken too great.

Instead of determining the deviations from particular solutions of the general differential equations, which in general can be found only with great difficulty, certain terms in the right members may be omitted until the variations from the approximate motion are computed. Suppose the differential equations of motion are

$$\frac{dx_i}{dt} = X_i^{(0)} + \sum_{j=1}^{\infty} X_i^{(j)} \mu^j \qquad (i=1, \cdots, n) , \tag{59}$$

where μ is a parameter. Suppose that the right members are convergent power series when the x_i have their initial values for $0 \leqq t < T$.

Suppose the differential equations

$$\frac{dx_i}{dt} = X_i^{(0)} \qquad (i=1, \ldots, n) \tag{60}$$

are integrated, giving for the particular initial conditions $x_1 = x_i^{(0)}$ the periodic solutions

$$x_i = f_i(t) \ , \tag{61}$$

valid for all finite values of the time.

Suppose the actual initial values of the variables $x_i = x_i^{(0)} + \epsilon a_i$, where the a_i are small and ϵ is a parameter which is to be put equal to unity in the final result. The actual co-ordinates at any time are

$$x_i = f_i(t) + \epsilon \xi_i \ , \tag{62}$$

where the ξ_i are unknown functions of the time to be determined. For this purpose substitute equations (62) in (59) and develop the right members as power series in ϵ and μ. These series will converge for sufficiently small values of ξ_i and μ, if the $X_i^{(j)}$ are analytic functions of the x_i and regular for $x_i = x_i^{(0)}$, while t varies from 0 to T. These conditions will always be fulfilled in the problems in which practical applications of this method would be desirable. After these transformations the differential equations become

$$\frac{d\xi_i}{dt} = \sum_{j,k=0}^{\infty} X_i^{(j,k)} \xi^k \mu^j \epsilon^k \qquad (i=1, \ldots, n) \ . \tag{63}$$

In accordance with the principles of § 5, these equations can be integrated as power series in μ and ϵ which converge for $0 < t < t_0$, the value of t_0 depending on the coefficients of the differential equations, the a_i and μ and ϵ. As in the preceding case, Poisson and secular terms will, in general, appear in the higher terms when the integration is carried out in this manner.

Hill's method of treating the lunar theory is in its essential features in agreement with the processes which have just been explained. He neglected in the right members of the differential equations all terms containing the latitude of the moon, the eccentricity of the sun's orbit, and the ratio of the distance of the moon from the earth to that of the sun—quantities which play the rôle of parameters, and then found periodic solutions of the resulting differential equations by properly determining the initial conditions. These solutions which give the variational orbit correspond to equations (61). They were found with rare ingenuity and great precision by Hill.[25] The part of the motion of the perigee depending on the ratio of the mean motions of the sun and moon and on the first power of the eccentricity of the moon's orbit was also found by Hill[26] with great accuracy. This motion introduces changes in the variational co-ordinates. The corresponding terms in this method are obtained by letting in the solutions of (63), which are of the form

$$\xi_i = \sum_{j,k=0}^{\infty} \xi_i^{(j,k)} \mu^j \epsilon^k \ , \tag{64}$$

$j = 0$ and $k = 0$. The differential equations which define these terms are

$$\frac{d\xi_i^{(0,0)}}{dt} = X_i^{(0,0)} \xi^{(0,0)} \ , \tag{65}$$

where the $X_i^{(0,0)}$ are periodic functions of the time. The solutions of this linear system are periodic with a period whose difference from that of the $X_i^{(0,0)}$ gives this part of the motion of the perigee.

[25] *American Journal of Mathematics*, Vol. I.

[26] *Acta Mathematica*, Vol. VIII.

The higher approximations have to a considerable extent been carried out by Brown, but the method of solution is somewhat different from that outlined here. The form of the solutions is assumed, or rather inferred from the investigations of earlier lunar theorists, the final results being expressed as purely periodic series. There is little doubt that, from a practical point of view, this is more satisfactory that any scheme admitting Poisson and secular terms with coefficients of low order in the parameters, but the assumption involved is unjustified, and the series attained are very probably divergent in the mathematical sense.

There seems to be some hope in the plan of finding a more exact periodic solution than the variational orbit, depending, of course, upon particular initial conditions, one which includes more of the right members of the differential equations, and then computing the deviations from this orbit. In this manner satisfactory expressions might be obtained which are rigorous for a long interval of time.[27]

[27] See POINCARÉ, *Méthodes nouvelles*, Vol. I, p. 82.

RADIAL VELOCITIES OF TWENTY STARS

RADIAL VELOCITIES OF TWENTY STARS HAVING SPECTRA OF THE ORION TYPE

Edwin B. Frost and Walter S. Adams

INTRODUCTION

The determination of the velocity of a star in the line of sight according to Doppler's principle was first attempted by Huggins in 1868. His observations were followed by those of Vogel three years later, and the validity of the method may be considered to have been established by these investigations, together with others dealing with the motions of planets and the rotation of the Sun. Visual observations of the displacements of the lines in stellar spectra from the positions of corresponding lines in the spectrum of a vacuum tube are, however, of extreme difficulty, and measurements which can be regarded as at all accordant are only possible with the most powerful telescopes and the brightest stars. It was not until the photographic method was applied to this class of observations by Vogel in 1887 that results of an accurate character were obtained. The determinations of the radial velocities of fifty-one stars by Vogel and Scheiner, described in detail in the seventh volume of the *Publicationen des Astrophysikalischen Observatoriums zu Potsdam*, constitute the foundation of the modern methods of observing stellar motions in the line of sight.

The next great advance was made by Campbell in his design of and work with the Mills spectrograph of the Lick Observatory, described in the *Astrophysical Journal*, Vol. VIII (1898), pp. 123–56. The use of iron as a comparison spectrum (previously tried by Vogel and by Deslandres, but not regularly employed by them), together with the closest attention to the optical and mechanical construction of the instrument and great refinement in the measurement of the plates, enabled Campbell to increase greatly the accuracy of the determinations, so that the natural unit became the kilometer per second, instead of the sevenfold greater German geographical mile employed by Vogel.

The necessity for the greatest attainable rigidity of the spectrograph, to prevent flexure, and for the maintenance of the prisms at a constant temperature, became apparent from the experience of all observers engaging in spectrographic work, and has led to further improvements in the current type of spectrograph, and tended to increase still further the precision of measurements of radial velocities. The observations given in the present paper constitute a part of the first year's work with the Bruce spectrograph of the Yerkes Observatory, which was completed in the autumn of 1901, and has since then been systematically used in determining stellar motions in the line of sight.

The spectra of the *Orion* type are of an especial interest to the astrophysicist, as they seem unquestionably to occupy a position very early in the scale of stellar evolution. Their chemical constitution is simple, the chief elements showing lines being hydrogen, helium, oxygen, silicon, nitrogen, and magnesium. The presence of helium is the principal characteristic of the type, whence they are frequently called helium stars. The broad and diffuse nature of most of the lines in these spectra renders them less adapted to precise measurement for radial velocity; moreover, the dispersion of the Bruce spectrograph is rather high for such lines, so that it is quite out of the question to expect any such accuracy in the determined velocities as may be obtained for stars of the solar type. A judgment as to the accuracy reached with this instrument, and with the methods employed in measuring and reducing the plates, should be based upon the results given in the section on the control plates of the Moon, planets, and certain standard stars of the solar class (pp. 18–32). The optical features of the Bruce spectrograph were especially planned, however, to cover a region of spectrum not naturally included by most of the large spectrographs engaged in line of sight work, and this region (centering near the strong helium line at λ 4471 and the characteristic magnesium line at λ 4481) was chosen as

particularly well suited for work on stars of the *Orion* type. These stars, furthermore, have hitherto been little observed for radial velocity, so that the field is a comparatively open one. The twenty stars included in this paper were not chosen by any definite principle of selection, but merely represent those stars of which three or more spectrograms have been obtained during the past year, from an observing list of something over one hundred stars shown to be of the *Orion* type by the investigations of Vogel and Wilsing.[1] But stars of this type previously known to be spectroscopic binaries, and those which have been found to be such during the progress of this work, have been excluded from the list. These last named are six in number, and will be discussed in due time elsewhere.

INSTRUMENTS

The Bruce spectrograph was designed and largely constructed at the Observatory, with funds provided by the late Miss Catherine W. Bruce, of New York city, amounting to twenty-three hundred dollars, supplemented by a grant of five hundred dollars from the Rumford fund of the American Academy of Arts and Sciences. As a detailed description of the spectrograph has already been published,[2] it will be necessary to recall here only some of the essential features of the instrument and its use in connection with the great Yerkes refractor. A correcting lens of 57 mm. aperture is placed in the cone of rays from the forty-inch objective, at a distance of about 100 cm. from the slit, and unites the rays so that the spectrum of a star is of uniform width for about 100 tenth-meters on either side of λ 4500.

The triple collimating lens, of 51 mm. aperture and 958 mm. focus, was replaced during the year by a quadruple "isokumatic" lens, designed by Professor Hastings, which was originally ordered but could not then be supplied. The new collimator is of the same aperture and focus, and slightly increases the field of good definition, which was already quite satisfactory.

The three prisms are of specially annealed Jena glass, figured by Brashear, and have angles of 64°34′, with an index for $\lambda = 4500$ of $n = 1.6724$. Their size is such as to transmit the full beam from the collimator of 51 mm. diameter, with allowance for the increased size of the beam after dispersion in the first and second prisms.

Two cameras are provided with the instrument; A, a Zeiss anastigmat of 71 mm. aperture and 449 mm. focus; and B, a Hastings triple of 76 mm. aperture and 607 mm. focus. The two series of plates taken with the spectrograph are designated as A and B according to the camera lens employed. The range of fair focus is somewhat greater in (tenth-meters) for the shorter camera, but the superior scale of camera B gives it the advantage in the range covered. The photographic "speed" of the two cameras is practically identical: the same exposure-time is required for the same object under equal atmospheric conditions. We account for this unexpected circumstance by the losses of light on passing through the five component lenses of the anastigmat.

Camera B has given us serious trouble by becoming astigmatic at intervals, without any known cause external to the lens. We have attributed this to strain produced by the cement (balsam), and the notes under the "journal of observations" show that the lens has been several times recemented by the maker. When a trial plate shows any defective performance of camera B (commonly fringes on the sides of the comparison lines), camera A is always used. It should be mentioned here that we find it much more accurate and satisfactory to test a lens by photographing the emission lines from metallic electrodes rather than the absorption lines of the solar spectrum. Of the plates referred to in this paper fifty-four have been taken with A and eighty-two with B.

The principal changes which have been made in the instrument since the descriptive article was written (in December, 1901) for the *Astrophysical Journal* (*loc. cit.*) are the following:

[1] "Untersuchungen über die Spectra von 528 Sternen," *Publicationen des Astrophysikalischen Observatoriums zu Potsdam*, Bd. XII, Theil I.

[2] EDWIN B. FROST, "The Bruce Spectrograph of the Yerkes Observatory," *Astrophysical Journal*, Vol. XV (1902), pp. 1-27.

The bar containing the windows, which determine the length of slit used at a given exposure (a single window for the star-light, a double window for spark-light), has been placed slightly in front of the slit instead of behind it, as formerly. This made the tips of the spark lines much sharper than they had been previously.

To insure the full and uniform illumination of the collimator lens by the light from the source of comparison spectrum, two changes and two additions have been made. The use of the concave mirror to project the image of the spark or tube upon the slit has been abandoned, as the electrodes themselves cut out an appreciable amount of the cone from the mirror, and admitted the possibility of non-uniform illumination of the collimator. The simple biconvex lens originally provided as an alternative has been regularly used for all of the later plates described in the journal of observations.

The plane silvered mirror at first used to reflect the comparison light 90° downward into the slit has been replaced by a diagonal prism.

A small ground glass diffusing screen has been mounted 20 mm. in front of the slit, and is turned into position when the comparison spectrum is being photographed. This shonld insure a uniform source filling a much larger angle than that subtended at the distance of the slit by the collimating lens, and it has proved entirely satisfactory. The idea was taken from the Potsdam spectrograph, where a ground glass screen diffuses the light from the arc lamp which there serves as the source of the comparison spectrum.

For testing the illumination of the collimator Campbell's practice has been followed of placing a photographic plate in a small holder directly over the aperture of the lens. The exposure is then made to the light of the spark. The negative gives a much more satisfactory test of the illumination than is possible by the usual visual method.

The method of guiding during the exposure on the star, by the light reflected from the symmetrically inclined slit-jaws, has proved very satisfactory. When desired, the observer can, by simply turning a pinion, throw into the guiding telescope the light of the star or spark reflected at the first surface of the first prism. The method thus combines the advantages of the methods of Huggins and of Vogel.

The temperature case which envelopes the whole spectrograph has also given entire satisfaction in its operation. Although the electric heating is not automatic, it has not been found too much of an inconvenience for the observer to read the thermometers from time to time during an exposure, and to turn on the current as necessary. A change of 1° C. in the temperature within the outer case usually causes a change of about 0°.1 within the inner case (prism-box).

THE PLATES OF SPECTRA

The dispersion and scale of the plates for cameras A and B are as follows:

Wave-Length	Angular Dispersion for One-Tenth Meter	Tenth-Meters per mm.	
		Camera A	Camera B
4300	45″.7	10.0	7.4
4500	33.8	13.5	10.1
4700	26.0	17.6	13.1

A test of the practical separation of close lines in the solar spectrum, photographed on fine-grained plates, gave almost identical results with those described for the Mills spectrograph and the largest Potsdam spectrograph. On the fastest plates, which are used for stellar spectra, the least separable distance is of course less, and is about 0.2 tenth-meters at the center of the plate (λ 4480).

The range of spectrum in sufficiently sharp focus for determining displacements for velocities is

on properly exposed plates—for Camera A, from about λ 4300 to λ 4700; for Camera B, from about λ 4340 to λ 4700. For merely qualitative work, the range usable would be considerably greater.

The plates used were Seed's "Gilt Edge" 27, and Cramer's "Crown." At the close of the period covered here Seed's double-coated, non-halation plates were tried, with very satisfactory results. The size of the negatives is $1\frac{5}{8}$ in.$\times$4 in. (42$\times$102 mm.). The developer employed was rodinal or hydrochinon, commonly the former.

Comparison spectrum.—The rotating drum of the spark apparatus provides for the use of three metallic electrodes and a vacuum tube. On the plates discussed in this paper we have always employed titanium, and sometimes, in addition, iron or chromium electrodes, or the helium tube (which contains hydrogen as an impurity and gives also the hydrogen lines). We have used titanium in preference to iron for the standard comparison spectrum for the past three years, and obtain with it sharper and more numerous lines in the region of spectrum covered than with iron. In order to suppress the air lines when iron is used, a small self-induction coil was constructed in 1899 by Leeds & Co., of Philadelphia, according to specifications of Frost. It has an outer diameter of about 40 mm. and a length of about 42 cm. and is separated into sections with binding posts, so that 50, 100, 200, or 500 turns, or any combination of them, may be used. There is no core. The coils are insulated in the same manner as for the secondary of an induction coil. The air lines with the iron spark are greatly cut down when fifty turns are used, and can be entirely suppressed with a greater number of turns. The lines of the other metallic spectra are also rendered sharper by the use of the self-induction.

The current for the primary of the induction coil furnishing the current for the spark is taken from the 110-volt mains, and is reduced by properly arranged resistance coils so that from four to fourteen volts can be tapped off. The induction coil is stationary, and the secondary current is carried in an excellent cable, reaching the spectrograph in any position of the telescope with comparatively little loss of potential.

MEASURING MACHINES

All our measurements of spectra were formerly made with the familiar Zeiss comparators, having two microscopes, one for the negative and the other for the graduated scale. While these instruments are excellent, and have the advantage of depending upon an invariable scale instead of a screw, they are nevertheless rather slow in action, and the eye is strained in alternating between the microscopes with their different degrees of illumination of field. In 1901 two screw machines were therefore ordered from William Gaertner & Co., of Chicago, according to specifications by Professors Hale and Frost, and they have been almost exclusively used in the measurements covered by this paper. An idea of the instrument may be gained from the accompanying plate. The box casting is 23 cm. long, 8.5 cm. wide, and 5 cm. deep. To this the microscope is attached at an angle convenient for observing. The stage or plate-carriage moves in accurately figured ways on a second carriage which moves with the nut of the micrometer screw. The stage may be unclamped from the lower carriage and may be rapidly moved in a direction accurately parallel to the axis of the screw, through a distance of 40 mm. This allows the plate to be quickly aligned under the microscope, and to be rapidly examined before it is measured. A fine screw at the observer's left permits a slight adjustment of the position of the stage after it is clamped to the lower carriage. Thus the stage may be set so that any desired reading of the micrometer screw will correspond to a given position on the plate. The screw is of 10 mm. diameter and 10 cm. length, with a pitch of one-half millimeter. Great care was given by Mr. Gaertner to its construction. The nut is 28 mm. long. A weight attached to it by a light wire over a pulley not shown in the figure removes the small amount of lost motion otherwise present. The screw head is 80 mm. in diameter and is graduated with 500 divisions, so that 1 division = 0.001 mm. or 1 micron (μ). Every tenth division is doubly numbered, *e. g.*, as 39 and 89, so that the readings can be taken off the head directly for a whole millimeter instead of a half (one revolution).

Whole millimeters are read from a scale along the ways of the carriage. The microscopes are from Zeiss, and have the valuable feature of a variable magnification (ranging from about six to thirty diameters) as the objective is moved along a graduated scale. The reticle was ruled on glass at the observatory, and consists of a single fine line and a close pair. There is also provided an eye-piece micrometer which is not used. The whole eye end, including the reticle, can be slightly rotated so that the lines can be made perpendicular to the motion of the screw.

METHOD OF MEASUREMENT

After the negative has been aligned so that the edge of the spectrum moves along some mark or dust particle in the field, the upper carriage or stage is moved so that any desired value is given to the initial setting, and is then clamped, after which it is moved only by the screw. We commonly first place the plate on the stage so that the violet end of the spectrum will appear toward the left in the microscope, when the micrometer settings will increase with the wave-lengths. Four settings are then made on each star line, alternating each time in the direction from which the line is brought under the "thread" of the reticle. Four settings are also made on each comparison line, two each on the portions of the comparison line above and below the star spectrum, with the same alternation in the direction of approaching the thread. Care is taken that there shall be no change in the illumination of the plate during the measurement, and the mirror is rarely touched between plates. A change in the angle of the mirror during measurement would be likely to produce a noticeable shift in the apparent position of the lines.

The point in the comparison line (dark on the negative) at which the line is bisected by the thread may be different according to the practice of different observers. Thus it is the habit of Frost to make the setting at a point one-third of the length of the comparison line away from its inner end; while Adams makes his settings on the inner tips of the comparison lines. On star lines, of course, the setting is always made at the center. The correction for curvature will therefore be regularly different for the two observers. In case of very strong comparison lines, the accuracy of the settings may be somewhat increased by the use of the double thread of the reticle, but this has been very seldom done in these measures. The single thread is invariably the more suitable for the star lines (white on the negative).

After the plate has been measured in one position it is reversed on the stage so that the violet end will appear toward the right in the microscope, and the micrometer readings will decrease with increasing wave-lengths. The new position is so adjusted that the readings will add up some convenient number of whole millimeters when combined with the corresponding readings for the previous position of the plate. If this whole number is 80, then the averages of the four settings in the second position of the negative will be successively subtracted from 80.0000, and the remainder will be very closely equal to the previous average, with which it is now combined to form the Mean of the Settings. If the measurements in the two directions are not made consecutively, the observer is careful to see that the second measure is made when the comparator is at the same temperature as at the first measure.

It should be understood that the measurement of a plate in each position is a single, homogeneous process, yielding results which may be considered absolute, within the limits of error involved. That is, the settings are not first made on a star line and then on a comparison line as a pair, giving a differential value of the distance between the two; but the settings are progressively made along the plate until the whole measurement is complete for that position on the stage. The question of the choice of lines to be measured is taken up in the next section.

1. *Length of lines* (*width of spectrum*).—Two sets of windows have been used during the year, each set yielding a different length of lines (both star and spark) for the two cameras. With the narrower windows the length of the lines of both star and comparison spectrum is 0.17 mm. for camera B, and 0.13 mm. for camera A; with the larger windows, which have been used almost exclusively since

October 31, 1901, the length is 0.40 mm. for camera B, and 0.29 mm. for camera A. With average conditions of atmospheric steadiness, it is necessary during the exposure to move the star image back and forth through a small amplitude on the slit by the electric slow-motions, in order that the width of the star spectrum may correspond to the full width of the window. On faint stars the star spectrum is usually kept somewhat narrower than the full width, thus diminishing the necessary exposure time.

2. *Curvature of the lines.*—Correction is made for the curvature of the comparison lines by means of tables computed by Ditscheiner's formula, which has been shown by Adams to be accurate for long slits.[3] The amount of the correction (x) is indicated for the two cameras by the following extracts from the tables. The distance from the center of the star lines to the point for which the correction applies is denoted by z:

z	Camera A x	Camera B x
0.10 mm.	0.00008 mm.	0.00006 mm.
.20	.00032	.00024
.30	.00072	.00054
.40	.00128	.00096
.50	.00208	.00149

This table is calculated for an index of refraction in the prism of $n = 1.6724$ for λ 4500. The difference is insensible in practice for other wave-lengths in the range of good focus of our plates.

METHOD OF REDUCTION

The fundamental principle of the method adopted here for the measurement and reduction of line of sight plates is that each negative shall be treated solely by itself and wholly independently of any other plate. This assumes that there is on each plate a sufficient number of well-defined comparison lines whose wave-lengths are accurately known, so that the wave-length of any point in that stellar spectrum can be determined with all necessary precision. Hence no corrections have to be applied on account of the temperature of the instrument at the time the plate was made, or to reduce the plate to the scale of some standard solar or metallic spectrum plate. It may be objected that with so stable an instrument as the Bruce spectrograph, the dispersion formula should be the same for all plates taken at the same temperature; hence always for the whole series of plates taken on a given night. This is readily admitted, but in practice the time spent in computing the Hartmann dispersion formula for each plate, with the use of the "Brunsviga" calculating machine, is no greater than that spent in adapting to a given formula the micrometer settings for each plate.

The three lines of the comparison spectrum taken for the standards in determining the constants, s_0, c, and λ_0, of the simple Hartmann formula

$$\lambda = \lambda_0 + \frac{c}{s - s_0}$$

are selected on the basis of their sharpness on the negative and their proper spacing near the two extremities and center of the measured portion of the plate. The correction for curvature is first applied to the mean of the eight settings on each of the lines of the comparison spectrum. (In some cases the correction for curvature has been applied in kilometers to the final mean of the radial velocities determined from the different star lines.) Then the wave-lengths of all the lines measured in both star and comparison spectrum are computed by the formula. In making the measurements the best (most sharply defined, and for solar stars simplest) star lines were selected, without reference to their occur-

[3] "The Curvature of the Spectral Lines in the Spectroheliograph," *Astrophysical Journal*, Vol. XI (1900), pp. 309-11.

rence in the comparison spectrum, provided only that their wave-lengths in the laboratory or in the solar spectrum are known. In every case where possible the nearest good comparison line to the selected star line is also measured. The second column of the detailed measurements, pp. 18 ff. and 33 ff., contains the computed wave-lengths. The differences between these computed values and the known wave-lengths of the comparison lines (as given in Rowland's tables for the solar spectrum) are now given in the third column as "Correction to Comp. Lines." Aside from the accidental errors of the settings, these indicate the departure of the formula from an exact representation of the wave-lengths. The corresponding corrections for the intervening star lines are interpolated between the appropriate values for the adjacent comparison lines, and are given in the fourth column.

The fifth column is entitled "Wave-length in Sun" in the case of plates of the Moon and solar stars, and is taken directly from Rowland's table. Where it is evident that two (or more) solar lines, too close to be separated by the spectrograph, have blended together in forming the line seen on the plate, the wave-length given is the result of the combination of Rowland's values of the constituent lines, with weights proportional to the estimates of their intensities in Rowland's table. A list is given below of the blends thus formed which occur in these measures.

In case of the stars of the *Orion* type the fifth column is entitled "Normal Wave-Length," and gives the best values we have been able to find for the laboratory or other determinations of the wave-lengths of the lines in question. Details as to these lines and the authorities for the wave-lengths are also given below.

The next column contains the displacement, or difference between the normal wave-length and the measured wave-length, after the latter has been corrected by the amount given in the fourth column. From the displacement the corresponding radial velocity for each star line is readily determined from our tables, computed with a value of the velocity of light of 299,860 km. per second.

In the case of stars of the *Orion* type, where the stellar lines vary greatly in their degree of diffuseness and consequent difficulty of accurate bisection, the observer assigns an arbitrary weight to the lines, which is given in the last column of the tables of measures. This weight is not assigned after an examination of the accordance of the settings, but commonly immediately upon making the first setting, and it represents the relative certainty that the observer felt as to his estimate (*Auffassung*) of the center of the line. When the observer gave a different estimate of weight in the two positions of the plate (violet toward left and violet toward right), the lower weight was taken. Inasmuch as the *Auffassung* is for such ill-defined and diffuse lines wholly a matter of individual psychology and physiology, the weights assigned to the same line on the same plate by the two observers may differ very considerably. To the same line on different plates of the same star quite different weights may be given by the same observer, since the conditions of exposure and development, and consequent intensity of the negative, never repeat themselves precisely.

The weighted mean of the determinations of velocity for all the lines is used as the radial velocity from that plate by that observer, but the unweighted mean is also given, for comparison, at the foot of column 7. These means were taken on the original reduction sheets where the computations were carried to 0.01 km., and hence may differ slightly from the means of the values when rounded to tenths as printed. Where several star lines could be measured, the difference between the weighted and simple mean is slight.

Attention may here be called to the entirely independent character of the measurements of the two observers on the same plate. The star lines measured and the comparison lines chosen as standards depend wholly upon the observer's judgment while the plate is under the microscope. The generally satisfactory accordance of the results for the same plate is evidence that the large discrepancies arising from the excessively diffuse and difficult character of some of the individual star lines are fairly well balanced in the effect on the result.

SOURCES OF ERROR

The sources of error in this work that most naturally suggest themselves may be classified as follows: (1) those due to the spectrograph; (2) those due to the measuring instrument; (3) those due to the observer or the mode of reduction; (4) those depending upon assumed physical conditions in the stellar and terrestrial sources of light. We proceed to enumerate under these heads the points which the experience of ourselves and others, with this and other instruments, has shown to be most open to error.

1. (*a*) *Flexure of the spectrograph and inadequate support of the prisms.*—This serious source of error, which was in evidence with the spectrograph first used with the forty-inch refractor, was fundamentally in mind in the design and construction of the Bruce spectrograph. It was accordingly made more rigid than any previous instrument of the kind, principally with steel construction, and we have detected no evidences whatever of error in this respect during a year's use of the spectrograph.

(*b*) *Imperfection of prisms.*—The experience with the first set of prisms supplied for the Bruce spectrograph, which has been recounted in the article by Frost already cited, gave us special reason for caution in respect to the homogeneity of the glass of the prisms. The surfaces, by the Brashear Company, easily fulfil all the requirements, as was also true of the first set. The numerous tests in the summer of 1901 did show that there was a slight difference in the performance of the thick and thin halves of the prisms, and that the definition was slightly improved by reducing the aperture to one-half. The gain in sharpness of the lines was not sufficient, however, to justify the loss of light, and the full aperture of 51 mm. of the collimated beam has been regularly used. The effect must be a slight broadening of the lines of the stellar spectrum and of the comparison spectrum, and hence the result upon the determination of the radial velocities should be very small, increasing the accidental errors but not producing systematic ones. It is not possible to use lines as close together in stellar spectra of the solar type as could be done with perfect prisms, but the effect on such "blends" would be accidental and not systematic.

(*c*) *Variations in the temperature of the prisms during exposure.*—This source of error is fully suppressed by the temperature case and electric heating. Although the control is not automatic the observer has little difficulty in maintaining the temperature of the air about the prisms within a range of 0°.2 C. during a winter night. In one respect our arrangements are not perfected in regard to temperature. When the dome is opened for solar observations during a considerable part of the day, the temperature in the spectrograph necessarily rises much higher than the normal value for the night, and consequently the temperature inside the glass of the prisms will be falling during the latter part of the afternoon and early evening. It would be desirable to have means for keeping the temperature of the spectrograph as low during the day as it is likely to be at night. However, as the exposures for the comparison spectrum are symmetrical with respect to the star exposure (except in the case of a few of the earlier plates), the effect of a lack of perfect uniformity in the temperature within the prisms will be to broaden the lines of the two spectra alike and to produce no systematic errors in radial velocities.

(*d*) *Behavior of lens of Camera B.*—The irregularly recurring astigmatism of this lens, mentioned on page 4, opens a possibility of systematic error. The effect generally is to produce a slight shading or fringe on the more refrangible side of the lines, which is more evident for the emission lines of the spark spectrum than for the absorption lines of the stellar spectrum. Hence there would be a tendency to make the settings too far toward the violet on the spark lines, which would yield too large a positive radial velocity for a stellar spectrum made when the lens was in the disturbed condition. We have always intended to use Camera A when B was thus affected, and to measure no B plates showing unsymmetrical comparison lines. If it has occurred that this condition was not noticeable though present, there may be a slight systematic effect on some of the B plates, but it does not appear on comparing the values obtained with the two cameras.

(*e*) *Adjustment of spark apparatus.*—The proper adjustment of the source of the comparison spectrum so that the collimator lens shall be fully and uniformly illuminated by it, is one of the most essential conditions in the use of the spectrograph. The angular apertures of the mirror first used for projecting the image of the spark upon the slit, and of the lens later substituted, were both more than twice as great as that of the collimator lens as seen from the slit. Within this latitude for maladjustment the position of the spark image (purposely somewhat out of focus) could be checked by direct observation of the polished jaws of the slit, or by the symmetry of the illumination of the double window as seen from behind the slit—both of which modes of observation are made possible by the arrangement of the guiding apparatus. On unscrewing the guiding telescope the collimator lens can be viewed directly by the light reflected from the first surface of the first prism, and the equality of its illumination tested while the spark is in action. The method of placing a photographic plate immediately over the lens has proved thoroughly satisfactory and more trustworthy than the visual method. It is not impossible that some of the early plates taken when the mirror was used may be open to danger of partial maladjustment of the spark; but if so, this should show in the control plates of Moon and stars (pp. 18 to 32), and there is no evidence of discrepancies which are not wholly within the range of the errors of observation (measurement).

2. *Errors due to the measuring instrument.*—The only source of error here of consequence lies in the screw. Optical distortions are not to be feared in the microscope, as only the center of the field is used and the recticle is fixed. It has a slight adjustment in position angle, so that the threads can be made parallel to the lines of the spectrum, even if the latter are not absolutely perpendicular to the length of the spectrum. A preliminary examination of the periodic errors of the screw showed that they were not large enough to require correction in the case of the *Orion* type stars, upon whose broad lines the errors of setting are necessarily large. They are, however, of a magnitude sufficient to affect the velocities derived from the sharp lines of solar stars. It has not been permissible, however, to delay this publication long enough to include them in our reductions, although a large part of the necessary observations have recently been made for both measuring machines.

It therefore remains to examine the probable effect of these errors upon the control plates. Measurements with machine G 2 (used by Adams) of a fixed distance on a glass scale, distributed over the part of the screw actually used, indicated a maximum departure from the mean of $\pm 2\mu$. If a star line were actually affected by this amount, the error in the velocity from that line would be about 2.6km. for B plates or 3.2km. for A plates. But the average departure would not exceed one-half of this, and in the best part of the screw it would not be over one-fourth. In the case of plates of the Moon a considerable number of the lines measured are also present in the comparison spectrum, so that the settings are made at practically the same part of the screw, and the periodic errors would be without effect. Since the plate is measured in both directions, starting at different readings of the head, the resulting error will be reduced by one-half on the average, but cannot be increased. Probably the effect on the velocity for the average line will not exceed three- or four-tenths of a kilometer, and as the mean velocity depends upon more than ten lines, it seems safe to believe that the radial velocity of the Moon or solar star from that plate will not be in error by over 0.1 km. on account of periodic errors of the screw. The progressive errors are quite negligible.

For machine G 1 (used by Frost), with which comparatively few of the control plates were measured, the maximum screw errors are somewhat less, not exceeding $\pm 1.5\mu$. The effect on the radial velocities measured will doubtless not exceed 0.1km.

In these machines some changes have been made, tending to remove the slight amount of lost motion noticed earlier. The weights taking up the lost motion were somewhat increased. As all settings have uniformly been made in alternate directions there does not seem to be reason for fear of uncertainty in the measures on this account.

3. (*a*) *Errors due to the observer.*—Measurements of negatives under the microscope are doubtless liable to a variety of subjective errors, which should be more constant than in case of visual measurements of a similar class at the telescope. The one most familiar is that of the different habit of setting upon the dark and light lines on the negative. The process is clearly quite different in placing a dark line of the reticle, or "thread," on the center of a white line in the stellar spectrum from that in bisecting the dark comparison line with the dark "thread." The former is the easier and surer process, although the experienced observer doubtless has his habit of setting too far toward the right or toward the left, though perhaps very slightly. In the more difficult process of centering black upon black the error is greater, and probably for most observers is a function of the intensity or size of the dark line. But this personality error is largely eliminated by the regular practice of reversing the plate under the microscope and remeasuring. Measurements by Frost in 1899 upon a positive of a plate of *Polaris* yielded the same difference for violet to left—violet to right as did the measures upon the negative, but with the sign reversed. The numerical value of this difference has been quite constant and large for Frost, for B plates about 4km., in the sense that a plate measured with violet to left would require a correction of -2km. For Adams the whole amount is about 1.7km. and the sign opposite, so that a plate measured with violet to left would require a correction of about $+1$km.

(*b*) *Errors due to the mode of reduction.*—It might be thought that an improvement would have been made in the reduction process by using the exponential form of Hartmann's formula. While the wave-lengths would thus have been a little more closely obtained, the gain would not have offset the increased expenditure of time. As a matter of fact, with the method used of correcting the formula at every point where a comparison line was measured (which occurred as near as possible to the position of each star line), the accuracy of the formula is of small consequence, and almost any formula could have been employed, provided only that the differences for short stretches of spectrum could be regarded as linear.

Probably it would also be regarded by some as advantageous to smooth out the accidental errors of settings on the comparison lines by a curve. We have feared the arbitrariness of curve drawing, and have ordinarily thrown the accidental errors upon the star line, although where two comparison lines have fallen close together, with no star line intervening, the mean correction has commonly been taken, valid for the mean wave-length. In a few cases of extrapolation beyond the limits of the formula there has been a slight uncertainty as to the proper correction to the "wave-length by formula" of the stellar lines, but the effect would be small.

To conform with Rowland's tables the reductions have been carried out so as to be accurate to the thousandth of the tenth-meter. This gives a specious precision to the displacement for the lines whose wave-lengths have been measured only to the hundredth. In general we should not wish to place any reliance on anything less than the whole kilometer for the best measurable of the *Orion* type stars; and in view of all the sources of error now discussed, many of them not correctable in our present state of knowledge, almost the same can be said for the stars of the solar type.

It has not been possible for us to give the time necessary for the duplicate calculation of the numerical quantities involved in our detailed reductions, so that errors doubtless occur. In general these must be small, however, as those involving an amount as large as 0.02 or 0.03 tenth-meters would be noticeable as breaking the smoothness of the run of the "corrections to comparison lines;" and all such cases have been checked. It does not seem to us likely that these errors in computation can affect the mean value of the radial velocity from any one plate by more than a very small fraction of a kilometer.

In the computation of some of the plates measured by Frost assistance was received from Miss Anne S. Young, research assistant at the observatory during the summer quarter of 1902.

4. *Errors due to assumptions as to physical conditions.*

(*a*) In adopting the wave-lengths given in Rowland's table for the solar spectrum for our spark lines, we obviously assume that the conditions in the sun's reversing layer and in the spark are

sufficiently alike as to pressure and otherwise to justify the procedure. Determinations of the wave-lengths of the lines in the spark spectrum of titanium, of an order of accuracy equal to that of Rowland's table, are not available, and there would perhaps be quite as much assumption in using arc wave-lengths as solar wave-lengths. It is a fact that the relative intensities of the *Ti* spark lines on our plates follow much more closely the estimates in Rowland's table than they do Hasselberg's estimates for the arc spectrum of *Ti*. This indicates that the principal dark lines in the solar spectrum due to titanium are enhanced lines, and it suggests that the conditions may have some degree of similarity in sun and spark.

Jewell has found a slight systematic difference between arc and solar wave-lengths,[4] the metallic lines being relatively displaced toward the violet by something like 0.01 to 0.02 tenth-meters. Correction was made for this in the determination of Rowland's standards,[5] as its origin was then supposed to be instrumental. Jewell interprets it as an effect of the density and pressure at the level in the solar atmosphere at which the particular line is produced. The direction of the displacement would indicate a greater pressure in the solar atmosphere than in the arc. If the spark lines are also shifted toward the red relatively to the arc, the effect upon our measured radial velocities might be diminished. The large shifts of this sort described by Haschek[6] were not confirmed in amount by preliminary experiments made at the Yerkes Observatory by Dr. N. A. Kent, who found shifts of only about the order of those measured by Jewell. In the present state of our knowledge we therefore cannot say with any certainty how much our results are affected by the use of solar wave-lengths for our *Ti* lines; but presumably by an amount corresponding to less than 0.02 tenth-meters, or about 1.4 km., and perhaps very much less. The sign, moreover, cannot be given.

(*b*) The assumption that stellar wave-lengths are the same as those for the corresponding elements in the laboratory, if incorrect, also renders our measurements of velocity liable to some uncertainty, at present indeterminate. There are some instances where a distinct difference in wave-length is indicated. The most conspicuous case is that of the line always attributed to magnesium, at λ4481. Laboratory determinations of this diffuse line in the spark spectrum (obtainable also in the rotating arc) give a value of about λ4481.32,[7] while the value obtained by Adams[8] from a number of plates of *Sirius*, and of γ *Geminorum* and θ *Leonis*, is 4481.40. The latter value also satisfies the measurements for most of the stars included in this paper, and it has uniformly been used, as we are not prepared to adopt the radical procedure of employing a still different value for the three or four stars for which an intermediate value of this wave-length would perhaps give velocities more accordant with those from other lines. The wave-length found for this line by Scheiner[9] in the spectra of eighteen stars of the first type is 4481.44 (Rowland's scale).

Finally, in respect to wave-lengths, it should perhaps be mentioned that a relative error of ± 0.01 tenth-meter in Rowland's value for a line would produce an error in our velocity for that line of $\pm$ 0.7km. Probably errors in Rowland's table as large as that are very rare, and Rowland may underestimate the accuracy of his standards in his statement "From the tests I have made on my standards, I am led to believe that down to wave-length 7000, a correction not exceeding $\pm$ 0.01 division of Ångström (1 part in 500,000), properly distributed, would reduce every part to perfect relative accuracy."[10]

Of course the precision of the absolute wave-lengths of Rowland's table does not affect our results.

[4] *Astrophysical Journal*, Vol. III (1896), pp. 89-113.

[5] H. A. ROWLAND, "On a Table of Standard Wave-Lengths of the Spectral Lines," *Memoirs of the American Academy of Arts and Sciences*, Vol. XII (1896), No. 2.

[6] *Astrophysical Journal*, Vol. XIV (1901), p. 184.

[7] HENRY CREW, *ibid.*, Vol. XVI (1902), p. 247.

[8] *Ibid.*, Vol. XV (1902), p. 216.

[9] *Publicationen des Astrophysikalischen Observatoriums zu Potsdam*, Bd. VII (1895), Theil II, p. 315.

[10] *Memoirs of the American Academy of Arts and Sciences*, Vol. XII, No. 2, p. 110.

WAVE-LENGTHS OF THE PRINCIPAL STAR LINES USED

The tables which follow contain all of the more important star lines which we have employed, with the exception of such lines as occur in stars of the solar type of spectrum and are not blends. As the wave-lengths of the latter are taken directly from Rowland's table of solar spectrum wave-lengths, it has not seemed necessary to repeat them here. For the sake of completeness the value of a displacement of one tenth-meter in kilometers per second for the various wave-lengths given is included in the tables.

(*a*) *Blends.*—While we have endeavored, as far as possible, in our measures of plates of the Moon, planets, and stars of the solar type of spectrum, to use only single lines, it has been found impossible to avoid blended lines entirely, as some of the best lines in the spectra are of this nature. In such cases we have assigned weights to the component lines according to the intensities given in Rowland's table. This procedure is evidently rigorous for the Moon and planets, and proves satisfactory in the case of most of the stellar lines used in the solar stars we have investigated. Occasionally, however, a line of slight intensity in the Sun rises to considerable intensity in a star and materially changes the wave-length of a blended line. In such a case the change shows itself by the systematic deviation of this line from the other lines of a plate, and the line is rejected after a sufficient number of plates have shown the deviation to be unquestionably systematic.

The decision as to what intensity a line should have in order to exert an influence upon a closely adjacent line is naturally somewhat arbitrary, and depends upon the quality of the plate considered. In general, however, our experience shows that upon a plate of quality suitable for good measurement a line of intensity "0" on Rowland's scale has an appreciable influence, while fainter lines may be neglected. But this does not hold if the adjacent line is overpoweringly strong, as in such a case the strong line may stand out clearly against the fainter without being influenced by it. A case of this sort is the iron line λ 4528.798 of intensity 8 in the solar spectrum, measures of which do not indicate any disturbing effect from the several faint lines near it.

The following table contains the wave-lengths of the blended lines most frequently used. For the sake of brevity, those which have been used but rarely are not included, but the wave-lengths employed in such cases, are given in column five of the detailed statement of the measurements on pp. 18 ff. and 33 f.:

Elements	Wave-Length	No. of km. per tenth-meter	Elements	Wave-Lengths	No. of km. per tenth-meter
Ti; Fe	4427.420	67.73	*Cr, Mn; Ti*	4501.422	66.61
Fe; Ti	4434.021	67.63	—, —	4515.475	66.40
Ca; Fe	4435.181	67.61	*Fe?; —; Ti*	4522.853	66.30
Zr Fe; Ti?	4450.597	67.37	—; *Fe*	4525.285	66.26
Mn; Ca	4456.030	67.29	—; *Cr; Fe*	4526.644	66.24
Ti, V, Zr; Mn	4457.656	67.27	*Ti;* —	4527.518	66.23
V; Mn; —	4460.460	67.23	*Ti Co;* —	4534.168	66.13
Ni; Fe	4466.701	67.13	*Fe; Ti-Co*	4519.767	65.91
Fe; Mn; Ni?	4472.958	67.04	*Cr; Co-Fe*	4565.750	65.68
Fe; Ag	4476.214	67.00	*Ca; Co, Fe*	4581.634	65.44
—, *Fe; Fe*	4482.376	66.90	*Cr; Fe*	4611.455	65.02
Cr; Zr	4497.016	66.68	*Fe; Cr, La*	4613.465	64.99

(*b*) *Oxygen and nitrogen lines.*—The wave-lengths of the following oxygen and nitrogen lines occurring in the spark spectrum of air have been determined by us on plates taken with the concave grating, with various elements serving as the spark electrodes. The values have been published in the *Astrophysical Journal*, Vol. XVI (1902), pp. 118-20. The identifications are those of Neovius.[11]

[11] *Bihang till K. Svenska Vet.-Akad. Handlingar*, Vol. XVII, 1891.

Element	Wave-Length	No. of km. per tenth-meter	Element	Wave-Length	No. of km. per tenth-meter
O	4317.272	69.46	*N*	4601.632	65.17
O	4319.762	69.41	*N*	4607.305	65.08
O	4345.677	69.00	*N*	4614.033	64.98
NO	4348.134	68.96	*N*	4621.548	64.88
O	4349.541	68.94	*N*	4630.703	64.75
O	4351.495	68.91	*O*	4638.937	64.64
O	4367.012	68.66	*O*	4641.886	64.60
O	4415.076	67.92	*N*	4643.244	64.58
O	4417.121	67.88	*O*	4649.250	64.49
NO	4447.163	67.42	*NO*	4650.925	64.47
O	4591.066	65.31	*O*	4661.728	64.32
O	4596.291	65.24			

(*c*) *Silicon lines.*—The following wave-lengths of the three silicon lines used by us are those given by Exner and Haschek,[12] who used the spark passing between electrodes of metallic silicon as the source of spectrum. The occurrence of these lines in the spectra of stars resembling *β Crucis* was observed by McClean and by Gill, and their origin was traced by Lunt in a careful series of experiments at the Cape Observatory. It is unfortunate that the wave-lengths, particularly that of the third line, cannot be more accurately assigned. This is doubtless due to their diffuse character in the spark spectrum, which was remarked by Exner and Haschek.

Wave-Length	No. of km. per tenth-meter
4552.75	65.87
4567.95	65.64
4574.9	65.51

(*d*) *Magnesium lines.*—The magnesium line at λ4352 occurs in the Sun, and accordingly its wave-length is given by Rowland. The wave-length of the line at λ4481 has been determined by Adams from measures of the spectra of stars of Vogel's type Ia,[13] and is discussed more fully on p. 13.

Wave-Length	No. of km. per tenth-meter
4352.083	68.90
4481.400	66.91

(*e*) *Helium lines.*—The wave-lengths of the helium lines which we have used are those given by Runge and Paschen.[14] The double lines at λ4471 and λ4713 have been blended, the weights assigned to the components being 6 and 1 for λ4471, and 3 and 1 for λ4713. (The intensities given by Runge and Paschen are respectively 6 and <1 and 3 and <1.)

Wave-Length	No. of km. per tenth-meter
4388.100	68.33
4437.718	67.57
4471.676	67.06
4713.308	63.62

[12] "Note on the Spectrum of Silicon," *Astrophysical Journal*, Vol. XII (1900), pp. 48, 49.

[13] "Some Results with the Bruce Spectrograph," *ibid.*, Vol. XV (1902), pp. 214-17.

[14] "On the Spectrum of Clèveite Gas," *ibid.*, Vol. III (1896), pp. 1-28.

JOURNAL OF OBSERVATIONS

The extract given below from the regular observing journal of the Bruce spectrograph furnishes the observational data for all of the plates discussed in the present article. The principal omissions are the numerical values of the focal settings of the collimator and camera, and of the focal scale of the telescope, upon which the position of the slit in the plane of the forty-inch objective depends. The last varies with the temperature, and its value is furnished by a table constructed from Barnard's results for the variation of the focal length of the telescope with the temperature. The collimator setting has been changed but once, and then on the occasion of the substitution of the "isokumatic" lens, to which reference has already been made, for the lens previously in use. The focal setting of Camera A has been kept practically unchanged, repeated tests during the severe weather of the winter showing no appreciable variation in focus. The recementing of the objective of Camera B has, however, necessitated changes of its focal setting on several occasions, as appears in the Remarks.

Most of the columns in the journal are self-explanatory. The length of exposure in seconds for the comparison spectrum is indicated by the number following the symbol of the element employed: thus "*Ti* 6" denotes an exposure of the titanium spark for six seconds. The time in reference to the star exposure at which the comparison spectrum is photographed is given in the two columns headed "Beginning" and "End," while an intermediate entry refers to the middle of the star exposure unless the time is expressly stated. The number of turns of self-induction in the secondary circuit of the spark coil is also given. The first (*i*) of the temperature entries always refers to the temperature inside the prism box, the second (*o*) to the temperature inside the large aluminium case which covers the spectrograph. The middle of the star exposure is given in Central Standard time.

In the case of nearly all of the exposures entered in the list below, the labor of guiding has been shared equally by the observer and Mr. F. R. Sullivan, engineer in charge of the telescope, to whom we are much indebted for this efficient assistance.

Object	Series and Number	Date	Middle of Exposure	Duration	Hour Angle at End	Slit Width	Comparison Beginning	Comparison End	Self-Induction	Temperature Beginning *i*	Temperature Beginning *o*	Temperature End *i*	Temperature End *o*	Seeing	Observer	Remarks
		1901	h. m.	m.	h. m.	mm.			turns							
α Tauri ..	B191	Sept. 4	14 01	25	E 3 15	0.028		*Ti* 6	350	26.2	26.2			Poor	A	New diagonal
β Orionis ..	A207	"	15 13	8	E 2 25	0.028		*Ti* 6	"	26.3	26.4			Fair	A	prism in
ε Orionis ..	A208	"	16 10	25	E 2 10	0.028	*Ti* 6		"	26.4	26.4	26.4	26.4	Fair	A	spark apparatus
γ Pegasi ...	A215	Sept. 5	15 28	45	W 2 45	0.015		*Fe* 48, *Ti* 4, *He* 5	350; 850	25.5	25.4	25.4	25.3	Fair	F	
γ Pegasi ...	A218	Sept. 6	11 07	55	E 1 35	0.028		*Ti* 6, *He* 5	" "	27.2	27.1	27.2	27.2	Fair to good	A	
γ Orionis ..	A224	Sept. 11	15 32	9	E 2 12	0.050	*Fe* 55, *Ti* 3, *He* 3		" "	16.7	16.5			Poor	F	
ζ Persei ...	A226	Sept. 12	12 01	62	E 3 35	0.050		*Ti* 7, *He* 5	" "	16.4	16.2	16.4	16.2	Poor	A	40-inch objective found to
γ Pegasi ...	A233	Sept. 18	8 50	44	E 3 00	0.035		*Ti* 6, *He* 7	" "	12.0	12.1	12.0	12.1	Good	A	be covered
ζ Persei ...	A235	"	12 26	55	E 3 00	0.035		*Ti* 6, *He* 6	" "	12.0+	12.0	12.0+	12.1	Good	A	with light
β Orionis ..	A237	"	14 52	8	E 2 15	0.035		*Ti* 6, *He* 6	" "	12.0+	12.2			Fair	A	dew
β Orionis ..	A243	Sept. 20	15 42	7	E 1 20	0.038		*Ti* 8, *He* 8	" "	11.1	11.4			Fair	A	
κ Orionis ..	A244	"	16 13	25	E 1 10	0.038		*Ti* 8, *He* 8	" "	11.2	11.4	11.2	11.4	Good	A	
γ Pegasi ...	A245	Sept. 26	8 05	55	E 3 10	0.038		*Ti* 10, *He* 10	" "	22.4	22.6	22.4	22.4	Fair	A	
Moon	A246	"	8 48	12	E 1 56	0.023		*Ti* 12, *Fe* 88	350	22.4	22.3			Fair	A	
β Orionis ..	A249	"	14 54	8	E 1 45	0.038		*Ti* 10, *He* 11	350; 850	22.4	22.4			Poor	A	
κ Orionis ..	A250	"	15 26	30	E 1 35	0.038	*Ti* 10, *He* 11		" "	22.4	22.2	22.4	22.4	Poor	A	Light clouds
ι Herculis.	A251	Sept. 27	8 35	80	W 4 10	0.038		*Ti* 8, *He* 9	" "	22.4	22.5	22.4	22.4	Poor	A	and thick
Moon	A253	"	10 22	20	E 1 5	0.030		*Ti* 7, *Fe* 60	350	22.4	22.4	22.4	22.2	Poor	A	haze
γ Orionis ..	A258	Oct. 2	15 34	23	E 0 35	0.038		*Ti* 8 ± *He* 20 ±	350; 850	11.6	12.1	11.5	10.4	Fair; poor	F	
ι Herculis.	A260	Oct. 3	9 30	80	W 5 25	0.038		*Ti* 7, *He* 17	" "	9.9	9.9	9.9	9.8	Poor to fair	A	
ε Cassiop..	A261	"	11 15	100	E 0 45	0.038		*Ti* 7 ±, *He* 15	" "	9.9	10.0	9.9+	9.6	Good to poor	A	Spark intermittent
β Orionis ..	A262	"	13 26	7	E 2 45	0.038		*Ti* 7, *He* 18	" "	9.9	10.0			Fair	A	
ζ Orionis ..	A263	"	14 42	22	E 1 56	0.038		*Ti* 7, *He* 17	" "	9.9	9.6			Poor	A	Thick haze
γ Pegasi ..	B191	Oct. 16	12 46	82	W 3 3	0.035	*Ti* 12, *He* 25		" "	7.2	6.9	7.3	6.8	Poor; bad	F	Camera lens
β Orionis ..	B195	Oct. 17	12 48	9	E 2 15	0.035		*Ti* 12, *He* 30	" "	5.5	5.5			Fair	A	recemented
κ Orionis ..	B196	"	13 24	35	E 2 15	0.035	*Ti* 11, *He* 28		" "	5.5	5.6	5.5	5.4	Poor	A	by Brashear
β Can.Maj.	B200	"	16 10	35	0 00	0.035		*Ti* 12, *He* 30	" "	5.5	5.4	5.5	5.6	Poor	A	
Moon	B202	Oct. 18	7 30	10	W 3 20	0.035		*Ti* 12 ±, *He* 60	350	12.1	12.3	12.25	12.35	....	F	
ι Herculis.	B203	"	9 27	150	W 7 00	0.035	*He* 30 ±, *Ti* 7 at 9:10		"	12.25	12.3	12.25	12.15	Very bad	F	
β Orionis ..	B207	"	14 07	24	E 1 00	0.035		*Ti* 15, *He* 90	"	12.1	11.8	12.25	12.2	Bad	F	
κ Orionis ..	A271	Oct. 23	13 26	27	E 1 47	0.035		*Ti* 9, *He* 40	"	19.5	20.3			Fair	A	New win-
ε Cassiop..	A275	"	14 35	70	W 3 40	0.018		*Ti* 6, *He* 40	"	19.5	20.8	19.5	19.3	Fair	A	dows in oc-
ε Cassiop .	A278	Oct. 25	8 08	100	E 2 45	0.038		*Ti* 12, *He* 120	"	12.7	12.8	12.7	12.7	Fair	A	culting bar;
ζ Cassiop..	A284	Oct. 31	7 50	90	E 1 15	0.050		*Ti* 14, *He* 50	50; 350	11.0	14.1	11.0	13.8	Good	A	mirror used
β Orionis ..	A281	"	13 58	7	E 0 25	0.050		*Ti* 11, *He* 55	" "	11.0	13.6			Good	A	for spark
κ Orionis ..	A285	"	14 21	22	E 0 20	0.050		*Ti* 11 ±, *He* 55	" "	11.0	14.1	11.0	13.8	Fair	A	Spark inter-
Moon	A286	"	15 00	17	....	0.050		*Ti* 14, *Fe* 100	50	11.0	14.3			....	A	mittent
β Can.Maj.	A287	"	15 35	22	W 0 20	0.050		*Ti* 11, *He* 50	50; 350	11.0	11.3	11.1	11.2	Fair	A	
β Can Maj.	A293	Nov. 1	15 26	11	W 0 25	0.050		*Ti* 11	50	11.4	11.7	11.7	11.9	Very good	F	
ζ Cassiop .	B211	Nov. 7	8 43	85	0 00	0.038		*Ti* 5	"	3.2	3.1			Excellent	FA	Camera lens recemented

Object	Series and Number	Date	Middle of Exposure	Duration	Hour Angle at End	Slit Width	Comparison Beginning	Comparison End	Self-Induction	Temperature Beginning *i*	Temperature Beginning *o*	Temperature End *i*	Temperature End *o*	Seeing	Observer	Remarks
		1901	12 06	9	h. m.	mm.			turns							
β Orionis..	B213	Nov. 7	15 00	35	E 1 45	0.038		Ti 7	50	3.3	3.0	3.3	2.8	Excellent	FA	
β Can.Maj.	B215	"	10 33	80	W 0 10	0.038		Ti 6½	"	3.2	3.4	3 2	3.0	Excellent	FA	
ζ Persei ...	B218	Nov. 8	14 06	9	E 1 15	0.038		Ti 7	"	4.9	5.2	5.1	5.2	Good; hazy	A	Temperature
β Orionis..	B220	"	14 39	25	W 0 15	0.038		Ti 7 ±	"	5.1+	4.8			Fair	A	rising
γ Orionis..	B221	"	h. m.	m.	W 0 45	0.038	Ti 7		"	5.1	5.4	5.1	4.9	Good	A	
Venus.....	B224	Nov. 13	5 34	17	W 2 45	0.038		Ti 14	"	8.5	8.5	8.5	8.2	Fair	F	Occulting bar
ε Orionis..	B228	"	13 50	28	E 0 15	0.038		Ti 14	"	7 6	6.6	7.7	7 0	Poor	F	readjusted
β Orionis..	B231	Nov. 14	13 19	9	E 0 10	0.038		Ti 12	"	9.0	9.0	9 0+	9.2	Good	A	
ζ Persei...	B232	"	14 04	62	W 2 48	0.038		Ti 7	"	9 0	9.2	9.0	8 8	Fair	A	Stopped by
α Arietis..	B233	Nov. 15	8 36	28	E 1 25	0.038		Ti 12	"	−1.1	−1.1	−1.1	−1.2	Good	F	clouds
β Orionis..	B237	"	12 52	9	E 0 30	0.038		Ti 11	"	−0.2	0.0	−0.4	−0.7	Good	F	
γ Pegasi..	B246	Nov. 27	6 11	83	E 0 45	0.025		Ti 11	"	0 8	1.0	0.8	0 4	Good to fair	FA	Clouds at end
ζ Cassiop..	B248	"	10 48	112	W 3 45	0.025	Ti 4	Ti 6½	"	0 9	0.9	0.9	0.3	Good	F	
β Orionis..	B252	"	15 22	14	W 2 50	0.025		Ti 10	"	0.9	0 4	0.9	0.5	Good	F	
Moon......	B254	Dec. 18	7 36	27	....	0.025		Ti 15	"	−15.7	−15.7	−15.6+	−15.8	4; 3	A	Hereafter
β Orionis..	B257	"	12 12	8	W 1 00	0.038		Ti 15	"	−15.8	−15 6			4; 2	A	transpar'ncy
β Orionis..	A297	Dec. 19	11 34	13	W 0 30	0.038		Ti 7	"	−13.6	−13.0			1-3; 2	A	and seeing
β Orionis..	B261	Dec. 31	9 12	8	E 1 10	0.025		Ti 12	"	−2.0	−2.3			4; 4	A	will be given
γ Orionis..	B262	"	9 39	25	E 0 45	0.025		Ti 10	"	−1.9+	−1.6	−2 0	−2.2	4; 4	A	in the order
		1902														named on a
β Orionis..	A300	Jan. 4	11 41	10	W 1 40	0.025		Ti 9	"	−6.6	−6.4			4; 2	A	scale of 0 to
Venus.....	A303	Jan. 8	5 28	17	....	0.025		Ti 12	"	+3.3	+3.7			4; 2	A	5, 5 denoting
β Orionis..	A306	"	12 15	8	W 2 28	0.025		Ti 9	"	3.6	3.6			4; 1	A	perfect con-
β Orionis..	B270	Jan. 9	8 41	8	E 1 10	0.025		Ti 11	"	3 2	3.2			4; 4	A	ditions
α Tauri....	B275	Jan. 16	8 15	25	E 0 20	0.020		Ti 27	350	−3.3	−3.2	−3.4	−3.6	4; 4	A	
β Orionis..	B277	"	11 02	8	W 1 50	0.020		Ti 22	"	−3.3	−3.1	−3.4	−3.6	4; 4	A	
β Orionis..	B282	Jan. 24	6 50	10	E 1 55	0.025		Ti 20	"	−3.8	−3.9			4; 4	A	
ζ Draconis	B290	Feb. 3	16 24	83	E 3 00	0.040	Ti 9 at 16:07	Ti 6	"	−13.7	−13.4	−13.7	−13.3	4; 4-3	A	
β Orionis..	A312	Feb. 10	8 54	10	W 1 15	0.020		Ti 30	"	−7.6	−7.4			4; 4	A	
ζ Draconis	A314	"	16 12	60	E 2 50	0.040	Ti 7	Ti 7	"	−7.6	−7.8	−7.5	−7.4	4-3; 4	A	
Moon......	A320	Feb. 19	7 20	37	E 2 20	0.033	Ti 11	Ti 12	"	−5.3	−5 0	−5.3	−5.1	4; 4	A	New isokumatic
ζ Draconis	A324	"	14 33	42	E 4 10	0.045	Ti 6 at 14 20; Ti 6 at 14 45		"	−5 2	−5.0	−5.2	−5.5	4; 4	A	collim lens used
τ Herculis.	A325	"	15 33	55	E 2 05	0.050	Ti 5	Ti 3	"	−5.2	−5 6	−5.2	−5.4	4-1; 4	A	from this point on
β Orionis..	A330	Mch. 3	7 44	14	W 1 30	0.025		Ti 25	"	−2.8	−2.8			2; 4	A	Sky very thick
α Boötis...	B293	Mch. 12	12 13	16	E 2 20	0.020		Ti 35	"	3 5	3.5			4; 3	A	
τ Herculis.	B295	"	16 09	47	E 0 20	0.045	Ti 12	Ti 10	"	3.5	3.4	3.5	3.3	4; 4	A	
κ Orionis..	B297	Mch. 13	8 29	30	W 2 30	0.040	Ti 10	Ti 11	"	9.3	9.3			4; 1-2	A	Seeing very
ε Orionis..	B298	"	9 11	35	W 3 25	0.040	Ti 10	Ti 10	"	9.3	9.4	9.3	9.2	3; 1	A	bad
γ Orionis..	B299	"	9 53	30	W 4 15	0.040	Ti 10	Ti 11	"	9.3	9.4			3; 1	A	
α Boötis...	B300	"	11 29	24	E 3 00	0.020		Ti 38	"	9.3	9.8			4; 2	A	
τ Herculis.	B301	"	13 36	80	E 2 30	0.040	Ti 10	Ti 10	"	9.2+	9.9	9.3	9.0	4; 2	A	
α Boötis...	A336	Mch. 26	12 59	25	E 0 20	0.020	Ti 10	Ti 12	"	8.7	8.6	8.7	8.6	3; 2	A	Lens used in
Moon......	A337	"	14 49	35	W 0 45	0.025	Ti 8	Ti 8	"	8.6+	8.6+			3; 2	A	spark appa-
α Boötis...	B304	April 2	9 51	22	E 3 20	0.020		Ti 10	"	2.0	2.3			4; 4	A	ratus from
γ Corvi....	B305	"	10 32	30	E 0 20	0.040	Ti 3	Ti 3	"	2.0	2 1	2.0	1.8	4; 3	A	this point
α Boötis...	B311	April 3	9 57	18	E 3 15	0.020	Ti 11		"	4.8	5.0			4; 4	A	
γ Corvi....	B312	"	10 32	30	E 0 30	0.040	Ti 3	Ti 4	"	4.8	4.6	4.9	5.2	4; 4	A	
τ Herculis.	B313	"	11 29	55	E 3 30	0.040	Ti 4	Ti 3	"	4.8	4.8	4.8	5 0	4; 4	A	
κ Orionis..	B315	April 9	7 47	28	W 3 35	0.038	Ti 3	Ti 3	"	8 0	8.5	8 1	8.5	3; 3	F	
ε Orionis..	B316	"	8 21	23	W 4 20	0.038		Ti 7	"			8.3	8.5	4; 4	F	
γ Orionis..	B317	"	9 04	27	W 5 10	0.038		Ti 7	"			8.4	8.6	2; 3	F	
Moon......	B323	April 16	11 12	35	W 3 50	0.028	Ti 6	Ti 9 ±	"	7.4	7.4	7.4	7.4	3; 4	A	
γ Corvi....	B324	"	12 15	35	W 2 05	0.040	Ti 8		"	7.4	7.4	7.4+	7 4	3; 4	A	
Moon......	B328	April 19	8 40	30	E 1 00	0.028	Ti 4 +	Ti 6	"	7.8	7.8	7.8	7 6	....	F	
η Leonis...	B329	"	9 43	61	W 2 10	0.040	Ti 3½		"	7.8	7 3	7.8	7 5	3; 2	F	
γ Corvi....	B330	"	11 03	60	W 1 15	0.040	Ti 3 +	Ti 3	"	7 8	7.3	7.8		3-1; 2	F	Cirrus clouds
η Leonis...	B333	April 23	9 31	65	W 2 10	0.040	Ti 3	Ti 3	"	9.7	9 6	9.7	9.6	....	F	
η Leonis...	B337	April 30	9 53	85	W 3 10	0.038	Ti 10		150	14.5	14 6	14.5	14 4	1;1	F	
α Boötis...	B342	May 7	11 17	26	W 0 30	0.023	Ti 4	Ti 3½	"	15.7	14.8	15.7	15 7	3; 2	F	
67 Ophiuchi	B347	May 14	13 14	114	E 0 10	0.038	Ti 2½	Ti 2½	"	11 3	11.9	11.3	10.8	2; 1	F	
ζ Draconis	B357	May 30	10 04	44	E 2 05	0.040	Ti 3	Ti 2	"	20 4	20.6	20 5	20.4	3-4; 4	F	Clouded over
Moon......	B363	June 20	12 55	30	W 1 05	0.030	Ti 3	Ti 4	350	16.2	16.0	16.2	16.2	3; 1	A	suddenly
67 Ophiuchi	B369	June 25	13 41	78	W 2 50	0.040	Ti 2	Ti 1	"	17 6	18.5	17.8	17.8	2; 2-3	F	
α Boötis...	B371	June 26	9 30	12 ±	W 1 40	0.025	Ti 2		"	16.4	16.4			2-0; 2	A	Stopped by
67 Ophiuchi	A346	July 7	11 32	81	W 1 25	0.035	Ti 6	Ti 4	"	28.6	29.4	28.5	28.0	4; 4	F	clouds
ε Delphini.	A349	July 11	11 55	102	E 0 20	0.033	Ti 5		"	22.8	22.7	22.8	22.5	3; 2	F	Clouds at end
Moon......	A350	July 16	8 28	40	E 0 20	0.030	Ti 5	Ti 5	"	23.4	23.9	23.6	24.2	2; 1	A	Temperature
ε Delphini.	A353	"	12 48	120	W 1 05	0.040	Ti 3	Ti 4	"	24 4	24 7	24 5	24 5	2; 2-1	A	rising
ζ Cassiop..	A355	July 22	13 10	100	E 2 20	0.038	Ti 35	Ti 25	"	20.3	20.6	20.3	19.8	2-3; 2-3	F	Ground glass
102 Hercu..	A358	July 23	11 53	130	W 3 05	0.040	Ti 18	Ti 25	"	22 7	22.6	22 7	22 6	2; 3-1	A	screen used
ε Delphini.	A359	"	13 59	93	W 2 25	0.010	Ti 20	Ti 30	"	22.7	22 6	22.7	22.8	2; 4	A	in front of
ε Delphini.	A363	July 31	10 45	110	E 0 10	0.040	Ti 40	Ti 45	"	25.5	25.5	25 4+	25.2	3; 1-2	A	slit for spark
η Lyræ....	A365	"	14 51	102	W 5 12	0.040	Ti 35	Ti 30	"	25.5	25 4	25 5	25 2	3; 2	A	exposure
102 Hercu..	B385	Aug. 11	10 10	90	W 2 20	0.038	Ti 25	Ti 25	"	17.8	17.8	17.8	17.6	4; 4	A	after this
γ Pegasi...	B395	Aug. 22	14 40	71	W 1 15	0.033	Ti 30, Cr 80	Ti 35, Cr 100	"	19.6	18 9			3; 3	F	date
102 Hercu..	B397	Aug. 27	9 00	120	W 2 28	0.040	Ti 60	Ti 50	"	22.2	22.0	22.2	22.2	3; 3-4	A	
ε Cassiop..	B399	"	12 49	62	E 1 50	0.038	Ti 45	Ti 45	"	22.2	22.4	22 2	22.0	3; 3	A	
Moon......	B401	"	15 47	37	E 3 25	0.038	Ti 40	Ti 45	"	22.2	22.4			3; 3	A	
102 Hercu..	B402	Sept. 3	9 10	150	W 3 15	0.043	Ti 60	Ti 60	"	16.8	16 9	16.8	16.4	4; 1-2	A	
ι Herculis.	B403	"	11 20	85	W 5 20	0.043	Ti 60	Ti 50	"	16.8	16.9	16.8	16.3	4; 2-3	A	
α Boötis...	A373	Sept. 6	7 43	15 ±	W 4 50	0.025		Ti 115	"	20.3	20.2			3-0; 2	A	Freq't clouds
η Lyræ....	A379	Sept. 7	10 20	120	W 3 20	0.038	Ti 45	Ti 40	"	19.4	19.6	19.6	19.7	4; 2	F	Strong wind
Moon......	B408	Sept. 13	10 13	35	W 1 32	0.038	Ti 40	Ti 40	"	12.7	12.7	12.7	12.4	3; 1	A	
η Lyræ....	B409	"	11 57	150	W 5 35	0.043	Ti 40	Ti 30	"	12.7	13.0	12 7	13 2	3; 1	A	
γ Pegasi...	B419	Oct. 9	11 53	80	W 1 45	0.038	Ti 20	Ti 27	"	12.5	12.8	12.5	12 0	2-3; 2-3	F	
η Lyræ....	B422	Oct. 15	14 12	120	W 3 45	0.040	Ti 20	Ti 20	"	15.4	15.4	15 4+	15.2	3; 3-4	A	
Moon......	B423	"	15 44	30	E 1 01	0.028	Ti 30	Ti 40	"	15.4	15.4	15.4	15.3	3; —	A	
ζ Persei....	B424	"	16 43	60	E 2 55	0.038	Ti 25	Ti 25	"	15.4	15.4	15.4	15 4	3; 4	A	
η Lyræ....	B427	Oct. 16	9 32	125	W 5 25	0.038	Ti 20	Ti 20	"	10.1	9.8	10.1	10.0	2; 3-2	F	Exposure cut
ζ Orionis..	B433	Oct. 29	19 04	25 ±	E 1 52	0.038	Ti 25	Ti 35	"	7.6	7.8	7.7	7.9	2-0; 1	A	off by clouds
ζ Orionis..	B434	"	19 45	24	E 1 12	0.038	Ti 30	Ti 35	"	7.7+	7.9			3; 2	A	from 10:00-
ζ Orionis..	B441	Oct. 30	21 19	16	W 0 27	0.038	He 30, Ti 60		"	12.7	12.5			4; 4-5	F	10:15
Moon......	B444	Nov. 6	13 38	40	W 2 54	0.033	Ti 60		"	7.1	7.1	7.1	6.9	3; —	F	
ε Can. Maj.	B451	"	21 47	30	0 00	0 033	Ti 30	Ti 30	"	7 2	7.4			4; 4	A	
ε Can. Maj.	B461	Nov. 19	20 59	37	W 0 02	0.045	Ti 25	Ti 25	"	9.8	9.4	9.7	10.1	3; 1	A	Dew on object glass

DETAILED MEASURES AND REDUCTIONS

CONTROL PLATES OF THE MOON, VENUS, AND SOLAR STARS

The following section contains the results of measures upon plates of the Moon, Venus, and certain stars with known velocities taken for the purpose of guarding against instrumental errors. The series covers practically the entire interval within which the measures given in the present paper occur, and no evidence is shown of the existence of errors of this nature. The measured velocity in the case of the Moon and Venus is compared with the computed velocity, and in the case of stars with the results of other observers for the same stars. Professor Campbell's convenient formulæ were used in the derivation of the theoretical velocity of the Moon and Venus.

The detailed measurements on the different plates follow. The plates of the Moon and Venus are grouped together and arranged in chronological order, while the separate stars are given in order of right ascension. The Greenwich mean time and hour angle given for each plate refer to the middle of the exposure. Following this is the name of the person who measured the plate, the magnifying power employed, and a brief statement as to the quality of the plate. Unless otherwise specified the comparator used by Frost was G 1, by Adams G 2.

The first column of the tables contains the means of the settings upon the individual lines. S denotes a line in the spectrum of the star, Moon, or planet, while a comparison line is indicated by the symbol of the element to which it is due.

In all cases where the curvature correction is given as a fraction of a millimeter at the foot of the tables, the readings upon the comparison lines given in the first column include this correction. In a few cases the correction for curvature is applied in kilometers to the end result.

The symbols V_a and V_d are employed in the reduction of a star's velocity to the Sun, V_a denoting the correction due to the velocity of the Earth in its orbit, and V_d the correction due to the Earth's diurnal rotation. The total reduction to the Sun is, therefore, $V_a + V_d$. The corrections for the orbital velocity of the Earth have been made with the use of Schlesinger's tables of star constants (*Astrophysical Journal*, Vol. X (1899), pp. 1–13), and the diurnal corrections are taken from a table constructed for the latitude of the Yerkes Observatory.

MOON—A 246

1901, September 26, G. M. T. 14ʰ 48ᵐ — Measured by F.
Hour angle E 1ʰ 56ᵐ — Poor plate — Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 32.0910	Standard	±0.000	....	4427.266		
S 32.1013	4427.392	....	±0.000	4427.420	−0.028	−1.9
Ti 32.6522	4434.150	+0.018	....	4434.168		
S 32.7836	4435.772	....	+0.029	4435.851	−0.059	−4.0
Ti 33.1646	4440.495	+0.020	....	4440.515		
S 33.3212	4442.447	....	+0.015	4442.510	−0.048	−3.2
S 33.4414	4443.949	....	+0.011	4443.976	−0.016	−1.1
S 33.7551	4447.883	....	+0.002	4447.892	−0.007	−0.5
Ti 33.8689	4449.315	−0.002	....	4449.313		
Ti 34.3556	4455.476	+0.009	....	4455.485		
S 34.4012	4456.056	....	+0.010	4456.030	+0.036	+2.4
Ti 34.5215	4457.588	+0.012	....	4457.600		
S 34.5254	4457.638	....	+0.012	4457.656	−0.006	−0.4
S 35.9614	4476.193	....	−0.023	4476.214	−0.044	−3.0
Ti 35.9625	4476.208	−0.023	....	4476.185		
Ti 36.3605	Standard	±0.000	....	4481.438		
S 36.4315	4482.375	....	−0.001	4482.376	−0.002	−0.1
S 37.3578	4494.715	....	−0.013	4494.738	−0.036	−2.4
Fe 37.3606	4494.751	−0.013	....	4494.738		
Ti 37.4770	4496.318	±0.000	....	4496.318		
Ti 38.6951	4512.915	−0.009	....	4512.906		

MOON A—246—*Continued*

Mean of Velocity	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 39.4200	4522.968	+0.006	....	4522.974		
S 39.5836	4525.257	....	+0.014	4525.285	−0.014	−0.9
Fe 39.8337	4528.771	+0.027	....	4528.798		
S 39.8362	4528.806	....	+0.027	4528.798	+0.035	+2.3
S 41.6063	4554.157	....	±0.000	4554.211	−0.054	−3.6
Ti 41.7092	Standard	±0.000	....	4555.662		

Curvature Cor. + 0.0002 mm. Mean − 1.2 km.
Computed Velocity − 0.5

MOON—A 253

1901, September 27, G. M. T. $16^h\ 22^m$ Measured by A.
Hour angle E $1^h\ 15^m$ Moon fair; comparison fair. Power 28

Ti 26.2727	Standard	±0.000	....	4399.935		
S 26.9485	4407.871	....	−0.002	4407.851	+0.018	+1.2
S 27.0037	4408.524	....	−0.002	4408.549	−0.027	−1.8
Fe 27.5735	4415.297	−0.004	....	4415.293		
S 28.4306	4425.615	....	−0.004	4425.608	+0.003	+0.2
Ti 28.5669	4427.270	−0.004	....	4427.266		
S 28.5774	4427.398	....	−0.004	4427.420	−0.026	−1.8
S 29.2661	4435.827	....	−0.002	4435.851	−0.026	−1.8
S 29.8072	4442.524	....	±0.000	4442.510	+0.014	+0.9
Ti 29.9238	4443.976	±0.000	....	4443.976		
S 30.2354	4447.871	....	±0.000	4447.892	−0.021	−1.4
Ti 30.3503	Standard	±0.000	....	4449.313		
Ti 30.8405	4455.498	−0.013	....	4455.485		
S 30.8828	4456.038	....	−0.013	4456.030	−0.005	−0.3
Ti 31.6612	4465.980	−0.005	....	4465.975		
S 32.4522	4476.234	....	−0.004	4476.214	+0.016	+1.1
Ti 32.8494	4481.441	−0.003	....	4481.438		
S 32.9185	4482.351	....	−0.003	4482.376	−0.018	−1.2
S 33.8508	4494.741	....	±0.000	4494.738	+0.003	+0.2
Ti 33.9683	Standard	±0.000	....	4496.318		
S 34.0221	4497.041	....	−0.001	4497.046	−0.006	−0.4
S 34.3461	4501.413	....	−0.006	4501.422	−0.015	−1.0
Ti 34.3489	4501.451	−0.006	....	4501.445		

Curvature Cor. +0.0001 mm. Mean −0.5 km.
Computed Velocity −0.6

VENUS—B 224

1901, November 13, G. M. T. $11^h\ 34^m$ Measured by A.
Hour angle W $2^h\ 36^m$ Planet strong; comparison good. Power 21

S 22.8566	4443.810	....	+0.018	4443.976	−0.148	−10.0
Ti 22.8725	4443.958	+0.018	....	4443.976		
S 23.2737	4447.696	....	+0.005	4447.892	−0.191	12.9
Ti 23.4465	Standard	±0.000	....	4449.313		
S 24.3103	4457.450	....	±0.000	4457.656	−0.206	13.9
Ti 24.3261	4457.600	±0.000	....	4457.600		
S 25.2597	4466.505	....	−0.005	4466.701	−0.201	13.5
S 25.4657	4468.486	....	−0.006	4468.663	−0.183	12.3
Ti 25.4848	4468.669	−0.006	....	4468.663		
S 25.9135	4472.810	....	−0.006	4472.958	−0.154	10.3
S 26.2453	4476.031	....	−0.006	4476.214	−0.189	12.7
Ti 26.7995	4481.444	−0.006	....	4481.438		
S 26.8762	4482.196	....	−0.005	4482.376	−0.185	12.4
S 28.1202	4494.513	....	+0.008	4494.738	−0.217	14.5

VENUS B—224—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Planet Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S 28.7897	4501.230	....	+0.015	4501.422	−0.177	−11.8
Ti 28.8095	4501.430	+0.015	....	4501.445		
Ti 29.9391	4512.911	−0.005	....	4512.906		
S 30.1705	4515.285	....	−0.007	4515.475	−0.197	13.1
Ti 30.4542	4518.207	−0.009	....	4518.198		
S 30.8831	4522.647	....	+0.008	4522.853	−0.198	13.1
Ti 30.9138	4522.966	+0.008	....	4522.974		
Ti 31.3180	Standard	±0.000	....	4527.490		
S 31.4518	4528.607	....	±0.000	4528.798	−0.191	12.6
S 32.9699	4544.641	....	+0.009	4544.845	−0.195	12.9
Ti 32.9899	4544.855	+0.009	....	4544.864		
Ti 33.7111	4552.616	+0.016	....	4552.632		
S 33.8378	4553.984	....	+0.009	4554.211	−0.218	14.4
Ti 33.9925	4555.662	±0.000	....	4555.662		
S 34.7268	4563.678	....	+0.010	4563.939	−0.221	14.5
Ti 34.7469	4563.899	+0.040	....	4563.939		
Ti 35.4926	4572.130	+0.026	....	4572.156		
S 36.3248	4581.424	....	+0.017	4581.634	−0.193	12.6
S 37.0751	4589.901	....	+0.009	4590.126	−0.216	14.1
Ti 37.0941	4590.117	+0.009	....	4590.126		
S 38.9256	4611.221	....	+0.002	4611.455	−0.232	15.1
Ti 39.4569	Standard	±0.000	....	4617.452		

Curvature Cor. +0.0009 mm. Mean −13.0 km.
Computed Velocity −12.8

MOON—B 254

1901, December 18, G. M. T. $13^h\ 36^m$ Measured by A.
Hour angle W $1^h\ 32^m$ Moon good; comparison rather strong. Power 21

S 23.4084	4442.519	....	+0.028	4442.510	+0.037	+2.5
Ti 23.5599	4443.948	+0.028	....	4443.976		
S 23.5648	4443.994	....	+0.028	4443.976	+0.046	+3.1
S 23.9804	4447.929	....	+0.007	4447.892	+0.044	+3.0
Ti 24.1260	Standard	±0.000	....	4449.313		
S 25.9346	4466.735	....	+0.008	4466.701	+0.042	+2.8
Ti 26.1311	4468.651	+0.009	....	4468.663		
S 26.1331	4468.676	....	+0.009	4468.663	+0.022	+1.5
S 26.8995	4476.209	....	−0.010	4476.214	−0.015	−1.0
Ti 27.4289	4481.461	−0.023	....	4481.438		
S 27.5242	4482.410	....	−0.023	4482.376	+0.011	+0.7
S 28.7507	4494.745	....	−0.029	4494.738	−0.022	−1.5
Ti 28.9085	4496.348	−0.030	....	4496.318		
S 29.4085	4501.450	....	−0.022	4501.422	+0.006	+0.4
S 30.0898	4508.459	....	−0.012	4508.455	−0.008	−0.5
Ti 30.5192	4512.911	−0.005	....	4512.906		
S 31.6950	4525.245	....	−0.001	4525.285	−0.041	−2.7
Ti 31.9069	Standard	±0.000	....	4527.490		
S 32.0338	4528.838	....	+0.002	4528.798	+0.042	+2.8
Ti 34.2333	4552.595	+0.037	....	4552.632		
S 34.3791	4554.197	....	+0.032	4554.211	+0.018	+1.2
Ti 35.2587	4563.935	+0.004	....	4563.939		
S 35.2583	4563.934	....	+0.004	4563.939	−0.001	−0.3
S 35.9126	4571.256	....	+0.012	4571.275	−0.007	−0.5
S 36.8271	4581.615	....	+0.026	4581.634	+0.007	+0.5
S 37.0370	4584.013	....	+0.027	4584.018	+0.022	+1.4
Ti 37.5662	4590.092	+0.034	....	4590.126		
S 39.3891	4611.405	....	+0.008	4611.455	−0.042	−2.7
S 39.5611	4613.447	....	+0.005	4613.465	−0.013	−0.8
Ti 39.8972	Standard	±0.000	....	4617.452		

Curvature Cor. +0.0007 mm. Mean +0.5 km.
Computed Velocity +0.9

VENUS—A 303

1902, January 8, G. M. T. $11^h\ 28^m$
Hour angle W $2^h\ 35^m$

Planet strong; comparison good.

Measured by A.
Power 28

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Planet Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S 19.3514	4282.435	....	±0.000	4282.565	−0.130	−9.1
Ti 19.3948	Standard	±0.000	....	4282.860		
S 19.4101	4283.010	....	±0.000	4283.169	−0.159	11.1
Ti 19.7313	4286.165	+0.003	....	4286.168		
Ti 19.8736	4287.569	−0.003	....	4287.566		
S 20.0575	4289.387	....	−0.003	4289.525	−0.141	9.9
S 20.4322	4293.110	....	−0.001	4293.241	−0.135	9.4
S 20.5327	4294.113	....	−0.001	4294.278	−0.169	11.8
S 21.3067	4301.892	....	−0.006	4302.039	−0.153	10.7
Ti 21.3264	4302.091	−0.006	....	4302.085		
Ti 21.7183	4306.071	+0.007	....	4306.078		
S 21.7862	4306.763	....	+0.006	4306.912	−0.143	10.0
Ti 22.3978	Standard	±0.000	....	4313.034		
S 22.5919	4315.038	....	−0.001	4315.209	−0.172	12.0
S 22.9415	4318.664	....	−0.001	4318.817	−0.154	10.7
Ti 23.1771	4321.121	−0.002	....	4321.119		
S 24.6832	4337.064	....	+0.001	4337.216	−0.151	10.4
Ti 24.7781	4338.083	+0.001	....	4338.084		
S 24.9997	4340.468	....	+0.002	4340.634	−0.164	11.3
Ti 25.3675	4944.448	+0.003	....	4944.451		
S 26.0460	4351.858	....	+0.002	4352.007	−0.147	10.1
S 27.1522	4364.132	....	±0.000	4364.274	−0.142	9.8
Ti 27.4820	Standard	±0.000	....	4367.839		

Curvature Cor. +0.0005 mm.

Mean −10.5 km.
Computed Velocity −11.3

MOON—A 320

1902, February 19, G. M. T. $13^h\ 20^m$
Hour angle E $2^h\ 38^m$

Moon strong; comparison good.

Measured by A.
Power 21

S 31.3732	4399.921	....	±0.000	4399.903	+0.018	+1.2
Ti 31.3744	Standard	±0.000	....	4399.935		
S 32.0370	4407.849	....	+0.003	4407.851	+0.001	+0.1
Ti 33.6288	4427.257	+0.009	....	4427.266		
S 34.1240	4433.410	....	+0.012	4433.390	+0.032	+2.2
Ti 34.1836	4434.155	+0.013	....	4434.168		
S 34.3183	4435.840	....	+0.011	4435.851	±0.000	±0.0
S 34.8483	4442.514	....	+0.005	4442.510	+0.009	+0.6
Ti 34.9634	4443.972	+0.004	....	4443.976		
S 34.9637	4443.975	....	+0.004	4443.976	+0.003	+0.2
S 35.2711	4447.884	....	+0.001	4447.892	−0.007	−0.5
Ti 35.3830	Standard	±0.000	....	4449.313		
Ti 36.0271	4457.594	+0.006	....	4457.600		
S 36.2492	4460.473	....	+0.007	4460.460	+0.020	+1.3
Ti 36.8753	4468.654	+0.009	....	4468.663		
S 36.8769	4468.675	....	+0.009	4468.663	+0.021	+1.4
S 36.9399	4469.504	....	+0.009	4469.511	+0.002	+0.1
S 37.4477	4476.219	....	+0.015	4476.214	+0.020	+1.3
Ti 37.8376	4481.420	+0.018	....	4481.438		
S 37.9107	4482.399	....	+0 016	4482.376	+0.039	+2.6
S 38.8237	4494.747	....	+0.002	4494.738	+0.011	+0.7
Ti 38.9387	Standard	±0.000	....	4496.318		
S 38.9949	4497.087	....	±0.000	4497.046	+0.041	+2.7
S 39.3121	4501.443	....	+0.007	4501.422	+0.028	+1.9
Ti 39.3118	4501.438	+0.007	....	4501.445		

Curvature Cor. +0.0005 mm.

Mean +1.1 km.
Computed Velocity +0.7

MOON—A 337

1902, March 26, G. M. T. $20^h 49^m$ — Measured by A.
Hour angle W $0^h 28^m$ — Moon fair; comparison rather strong. — Power 20

Mean of Settings		Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
	mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S	29.3924	4425.611	....	±0.000	4425.608	+0.003	+0.2
Ti	29.5265	Standard	±0.000	....	4427.266		
S	29.5386	4427.415	....	±0.000	4427.420	−0.005	−0.3
S	30.1644	4435.174	....	−0.002	4435.184	−0.012	−0.8
S	30.7503	4442.519	....	−0.005	4442.510	−0.004	+0.3
Ti	30.8661	4443.981	−0.005	....	4443.976		
S	30.8668	4443.989	....	−0.005	4443.976	+0.008	+0.5
S	31.1765	4447.913	....	−0.014	4447.892	+0.007	+0.5
Ti	31.2881	4449.331	−0.018	....	4449.313	·	
S	32.6364	4466.708	....	−0.017	4466.701	−0.010	−0.7
S	32.7860	4468.663	....	−0.017	4468.663	−0.017	−1.1
Ti	32.7873	4468.680	−0.017	....	4468.663		
S	33.3607	4476.225	....	−0.012	4476.214	−0.001	−0.1
S	33.8257	4482.403	....	−0.008	4482.376	+0.019	+1.3
S	34.7138	4494.760	....	−0.001	4494.738	+0.021	+1.4
Ti	34.8584	Standard	±0.000	....	4496.318		
S	35.2334	4501.439	....	−0.001	4501.422	−0.016	+1.1
Ti	35.2339	4501.446	−0.001	....	4501.445		
Ti	36.0654	4512.928	−0.022	....	4512.906		
S	36.2473	4515.470	....	−0.012	4515.475	−0.017	−1.1
S	36.7744	4522.826	....	+0.018	4522.853	−0.009	−0.6
Ti	36.7803	4522.956	+0.018	....	4522.974		
Ti	37.0998	4527.481	+0.009	....	4527.490		
S	37.1925	4528.799	....	+0.000	4528.798	+0.010	+0.7
Ti	38.8393	4552.617	+0.015	....	4552.632		
Ti	39.6038	Standard	±0.000	....	4563.939		
S	39.6048	4563.954	....	±0.000	4563.939	+0.015	+1.0

Curvature Cor. +0.0005 mm. — Mean +0.1 km.
Computed Velocity +0.1

MOON—B 328

1902, April 19, G. M. T. $14^h 40^m$ — Measured by A.
Hour angle E $1^h 15^m$ — Moon good; comparison good. — Power 17

S	28.5408	4415.250	....	±0.000	4415.244	+0.006	+0.4
Ti	28.8334	4417.884	±0.000	....	4417.884		
Ti	29.8664	Standard	±0.000	....	4427.266		
S	29.8839	4427.426	....	±0.000	4427.420	+0.006	+0.4
S	30.8023	4435.879	....	+0.007	4435.851	+0.035	+2.4
S	31.5146	4442.508	....	+0.013	4442.510	+0.011	+0.7
Ti	31.6699	4443.962	+0.014	....	4443.976		
S	31.6724	4443.983	....	+0.014	4443.976	+0.021	+1.4
S	32.0910	4447.920	....	−0.004	4447.892	+0.024	+1.6
Ti	32.2397	4449.323	−0.010	....	4449.313		
S	32.9485	4456.049	....	−0.002	4456.030	+0.017	+1.1
Ti	33.1109	Standard	±0.000	....	4457.600		
S	33.1168	4457.656	....	±0.000	4457.656	±0.000	±0.0
S	34.2596	4468.667	....	−0.006	4468.663	−0.002	−0.1
Ti	34.2598	4468.669	−0.006	....	4468.663		
S	35.0342	4476.230	....	±0.000	4476.314	+0.016	+1.1
Ti	35.5624	4481.434	+0.004	....	4481.438		
S	35.6585	4482.385	....	+0.004	4482.376	+0.013	+0.9
S	36.8951	4494.737	....	±0.000	4494.738	−0.001	−0.1
Ti	37.0518	Standard	±0.000	....	4496.318		
Ti	37.5576	4501.444	+0.001	....	4501.445		
S	37.5578	4501.446	....	+0.001	4501.422	+0.025	+1.7

Curvature Cor. +0.0008 mm. — Mean +0.9 km.
Computed Velocity +0.9

MOON—B 363

1902, June 20, G. M. T. $18^h\ 55^m$ — Measured by A.
Hour angle W $0^h\ 50^m$ — Moon fair; comparison good. — Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S 19.1323	4425.622	....	±0.000	4425.608	+0.014	+1.0
Ti 19.3130	Standard	±0.000	....	4427.266		
S 19.3330	4427.448	....	±0.000	4427.420	+0.028	+1.9
S 20.2503	4435.860	....	+0.017	4435.851	+0.026	+1.8
S 20.9677	4442.513	....	+0.029	4442.510	+0.032	+2.2
S 21.1205	4443.939	....	+0.032	4443.976	−0.005	−0.3
Ti 21.1210	4443.944	+0.032	....	4443.976		
S 21.5405	4447.873	....	+0.027	4447.892	+0.008	+0.5
Ti 21.6909	4449.288	+0.025	....	4449.313		
Ti 22.3462	Standard	±0.000	....	4455.485		
S 22.4025	4456.020	....	+0.001	4456.030	−0.009	−0.6
S 23.7181	4468.645	....	+0.034	4468.663	+0.016	+1.1
Ti 23.7164	4468.629	+0.034	....	4468.663		
S 24.4939	4476.201	....	+0.020	4476.214	+0.007	+0.5
Ti 25.0256	4481.427	+0.011	....	4481.438		
S 25.1198	4482.358	....	+0.011	4482.376	−0.007	−0.5
S 26.3633	4494.754	....	+0.015	4494.738	+0.031	+2.1
Ti 26.5171	4496.302	+0.016	....	4496.318		
S 26.5898	4497.036	....	+0.016	4497.052	+0.006	+0.4
S 27.0243	4501.434	....	±0.000	4501.422	+0.012	+0.8
Ti 27.0254	Standard	±0.000	....	4501.445		

Curvature Cor. +0.0008 mm. — Mean +0.8 km.
Computed Velocity +0.2

MOON—B 363

Measured by F.
Power 23

Ti 30.6616	Standard	±0.000	....	4427.266		
S 30.6809	4427.442	....	±0.000	4427.420	+0.022	+1.5
Ti 31.4173	4434.189	−0.021	....	4434.168		
S 31.5268	4435.199	....	−0.021	4435.184	−0.006	−0.4
S 32.3159	4442.536	....	−0.004	4442.510	+0.022	+1.5
Ti 32.4724	4443.977	−0.001	....	4443.976		
S 32.4726	4443.978	....	−0.001	4443.976	+0.001	+0.1
S 32.8904	4447.893	....	−0.009	4447.892	−0.008	−0.5
Ti 33.0428	4449.327	−0.014	....	4449.313		
S 33.3024	4451.776	....	−0.016	4451.752	+0.008	+0.5
Ti 33.6958	4455.503	−0.018	....	4455.485		
S 33.7513	4456.031	....	−0.018	4456.030	−0.017	−1.1
Ti 34.7906	4465.985	−0.010	....	4465.975		
S 35.0678	4468.664	....	−0.014	4468.663	−0.013	−0.9
Ti 35.3524	4471.426	−0.018	....	4471.408		
S 35.8438	4476.220	....	−0.009	4476.214	−0.003	−0.2
Ti 36.3748	Standard	±0.000	....	4481.438		
S 36.4713	4482.390	....	±0.000	4482.375	+0.015	+1.0
S 37.7111	4494.742	....	−0.003	4494.738	+0.001	+0.1
Ti 37.8680	4496.321	−0.003	....	4496.318		
S 37.9397	4497.044	....	−0.003	4497.046	−0.005	−0.3
S 38.3715	4501.412	....	+0.010	4501.448	−0.026	−1.7
Ti 38.3741	4501.438	+0.010	....	4501.448		
S 39.0627	4508.459	....	−0.002	4508.455	+0.002	+0.1
Ti 39.4964	4512.917	−0.011	....	4512.906		
S 40.2157	4520.372	....	−0.002	4520.397	−0.027	−1.8
Ti 40.4650	Standard	±0.000	....	4522.974		
S 40.4530	4522.849	....	±0.000	4522.871	−0.022	−1.5
Ti 40.8955	4527.489	+0.001	....	4527.490		
S 41.0209	4528.810	....	+0.001	4528.798	+0.013	+0.9

Curvature Cor. + 0.0013 mm. — Mean − 0.2 km.
Computed Velocity + 0.2

MOON—A 350

1902, July 16, G. M. T. $14^h 28^m$
Hour angle E $0^h 42^m$

Moon fair; comparison fair.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m	t. m.	t. m.	t. m.	km.
Ti 30.3399	Standard	±0.000	....	4427.266		
S 30.3552	4427.454	....	±0.000	4427.420	+0.034	+2.3
S 30.9807	4435.178	....	+0.006	4435.184	±0.000	±0.0
S 31.5670	4442.498	....	+0.012	4442.510	±0.000	±0.0
Ti 31.6836	4443.963	+0.013	....	4443.976		
S 31.9918	4447.891	....	−0.004	4447.892	−0.005	−0.3
Ti 32.1081	4449.323	−0.010	....	4449.313		
Ti 32.5937	4455.506	−0.021	....	4455.485		
S 32.6366	4456.055	....	−0.021	4456.030	+0.004	+0.3
Ti 33.6143	4468.682	−0.019	....	4468.663		
S 34.1884	4476.204	....	−0.008	4476.214	−0.018	−1.2
Ti 34.5843	Standard	±0.000	....	4481.438		
S 34.6546	4482.372	....	−0.001	4482.376	−0.005	−0.3
S 35.5784	4494.753	....	−0.010	4494.738	+0.005	+0.3
Ti 35.6948	4496.329	−0.011	....	4496.318		
S 35.7484	4497.055	....	−0.011	4497.046	−0.002	−0.1
S 36.0693	4501.421	....	−0.013	4501.422	−0.014	−0.9
Ti 36.0720	4501.458	−0.013	....	4501.445		
S 37.0281	4514.625	....	−0.006	4514.617	+0.002	+0.1
Ti 37.9457	Standard	±0.000	....	4527.490		
S 38.0405	4528.832	....	−0.001	4528.798	+0.033	+2.2
S 38.4194	4534.221	....	−0.010	4534.168	+0.043	+2.8
Ti 38.4714	4534.964	−0.011	....	4534.953		

Curvature Cor. +0.0005 mm.

Mean +0.4 km.
Computed Velocity +0.4

MOON—B 401

1902, August 27, G. M. T. $21^h 47^m$
Hour angle E $3^h 44^m$

Moon slightly weak; comparison fair.

Measured by A.
Power 28

S 29.0862	4425.591	....	±0.000	4425.608	−0.017	−1.2
Ti 29.2702	Standard	±0.000	....	4427.266		
S 29.2843	4427.395	....	±0.000	4427.420	−0.025	−1.7
S 30.9248	4442.512	....	+0.003	4442.510	+0.005	+0.3
S 31.0788	4443.948	....	+0.003	4443.976	−0.025	−1.7
Ti 31.0814	4443.973	+0.003	....	4443.976		
S 31.4988	4447.881	....	+0.001	4447.892	−0.010	−0.7
Ti 31.6510	4449.312	+0.001	....	4449.313		
Ti 32.3053	4455.495	−0.010	....	4455.485		
S 32.3612	4456.026	....	−0.010	4456.030	−0.014	−0.9
S 33.6784	4468.651	....	−0.018	4468.663	−0.030	−2.0
Ti 33.6815	4468.681	−0.018	....	4468.663		
S 34.4556	4476.208	....	−0.008	4476.214	−0.014	−0.9
Ti 34.9886	Standard	±0.000	....	4481.438		
S 35.0827	4482.365	....	±0.000	4482.376	−0.011	−0.7
S 36.3213	4494.714	....	−0.003	4494.738	−0.027	−1.8
S 36.9885	4501.408	....	−0.005	4501.422	−0.019	−1.3
Ti 36.9927	4501.450	−0.005	....	4501.445		
S 39.0727	4522.824	....	+0.003	4522.853	−0.026	−1.7
Ti 39.0868	4522.971	+0.003	....	4522.974		
S 39.3065	4525.266	....	+0.001	4525.285	−0.018	−1.2
Ti 39.5187	Standard	±0.000	....	4527.490		
S 39.6431	4528.797	....	±0.000	4528.798	−0.001	−0.1

Curvature Cor. +0.0008 mm.

Mean −1.1 km.
Computed Velocity −1.5

MOON — B 408

1902, September 13, G. M. T. 16^h 13^m
Hour angle W 1^h 14^m

Moon good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 31.7436	Standard	±0.000	....	4427.266		
S 31.7599	4427.415	....	±0.000	4427.420	−0.005	−0.3
S 32.4112	4433.390	....	+0.005	4433.390	+0.005	+0.3
S 33.3929	4442.495	....	+0.011	4442.510	−0.004	−0.3
S 33.5520	4443.982	....	+0.012	4443.976	+0.018	+1.2
Ti 33.5501	4443.964	+0.012	....	4443.976		
S 33.9700	4447.904	....	+0.005	4447.892	+0.017	+1.2
Ti 34.1194	4449.311	+0.002	....	4449.313		
Ti 34.7714	4455.486	−0.001	....	4455.485		
S 34.8303	4456.046	....	−0.001	4456.030	+0.015	+1.0
Ti 34.9933	Standard	±0.000	....	4457.600		
S 34.9984	4457.648	....	±0.000	4457.656	−0.008	−0.5
Ti 36.1445	4468.671	−0.008	....	4468.663		
S 36.1456	4468.682	....	−0.008	4468.663	+0.011	+0.7
S 36.9185	4476.214	....	−0.006	4476.214	−0.006	−0.4
Ti 37.4503	4481.443	−0.005	....	4481.438		
S 37.5453	4482.381	....	−0.005	4482.376	±0.000	±0.0
S 38.7829	4494.718	....	±0.000	4494.738	−0.020	−1.3
Ti 38.9418	Standard	±0.000	....	4496.318		
S 39.0126	4497.032	....	±0.000	4497.046	−0.14	−0.9

Curvature Cor. + 0.0009 m.

Mean + 0.1 km.
Computed Velocity + 0.2

MOON — B 423

1902, October 15, G. M. T. 15^h 44^m
Hour angle E 1^h 1^m

Moon good; comparison good.

Measured by A.
Power 21

Ti 33.6163	Standard	±0.000	....	4427.266		
S 33.6324	4427.413	....	±0.000	4427.420	−0.007	−0.5
S 35.2019	4441.876	....	+0.006	4441.881	+0.001	+0.1
S 35.2673	4442.485	....	+0.006	4442.510	−0.019	−1.3
S 35.4234	4443.942	....	+0.007	4443.976	−0.025	−1.7
Ti 35.4262	4443.969	+0 007	....	4443.976		
S 35.8448	4447.891	....	+0.005	4447.892	+0.004	+0.3
Ti 35.9956	4449.309	+0.004	....	4449.313		
Ti 36.6475	4455.475	+0.010	....	4455.485		
S 36.7044	4456.016	....	+0.007	4456.030	−0.007	−0.5
Ti 36.8708	Standard	±0.000	....	4457.600		
S 36.8771	4457.660	....	±0.000	4457.656	+0.004	+0.3
S 38.0184	4468.625	....	+0.006	4468.663	−0.032	−2.1
Ti 38.0218	4468.657	+0.006	....	4468.663		
S 38.7970	4476.206	....	+0.011	4476.214	+0.003	+0.2
Ti 39.3279	4481.423	+0.015	....	4481.438		
S 39.4226	4482.357	....	+0.015	4482.376	−0.004	−0.3
S 40.6621	4494.707	....	+0.017	4494.738	−0.014	−0.9
Ti 40.8205	4496.301	+0.017	....	4496.318		
S 40.8926	4497.028	....	+0.015	4497.046	−0.003	−0.2
S 41.3250	4501.401	....	±0.000	4501.422	−0.021	−1.4
Ti 41.3293	Standard	±0.000		4501.445		

Curvature Cor. + 0.0008 mm.

Mean − 0.6 km.
Computed Velocity − 0.4

MOON—B 444

1902, November 6, G. M. T. $13^h\ 38^m$ — Measured by A.
Hour angle W $2^h\ 54^m$ — Moon good; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 31.0166	Standard	±0.000	....	4427.266		
S 34.0332	4427.418	....	±0.000	4427.420	−0.002	−0.1
S 34.6862	4433.410	....	−0.014	4433.390	+0.006	+0.4
Ti 34.7701	4434.184	−0.016	....	4434.168		
S 34.9510	4435.856	....	−0.010	4435.851	−0.005	−0.3
S 35.6659	4442.504	....	+0.012	4442.510	+0.006	+0.4
Ti 35.8214	4443.959	+0.017	....	4443.976		
S 35.8245	4443.988	....	+0.017	4443.976	+0.029	+2.0
S 36.2407	4447.897	....	+0.005	4447.892	+0.010	+0.6
Ti 36.3907	4449.312	+0.001	....	4449.313		
Ti 37.0401	4455.471	+0.014	....	4455.485		
S 37.1005	4456.047	....	+0.010	4456.030	+0.027	+1.8
Ti 37.2632	Standard	±0.000	....	4457.600		
S 37.2718	4457.682	....	±0.000	4457.656	+0.026	+1.7
S 38.4118	4468.668	....	−0.009	4468.663	−0.004	−0.3
Ti 38.4123	4468.672	−0.009	....	4468.663		
S 39.1858	4476.228	....	+0.008	4476.214	+0.022	+1.5
Ti 39.7123	4481.419	+0.019	....	4481.438		
S 39.8069	4482.356	....	+0.018	4482.376	−0.002	−0.1
S 41.0457	4494.743	....	+0.002	4494.738	+0.007	+0.5
Ti 41.2016	Standard	±0.000	....	4496.318		
S 41.2751	4497.061	....	±0.000	4497.046	+0.015	+1.0
S 41.7048	4501.425	....	+0.001	4501.422	+0.004	+0.3
Ti 41.7067	4501.444	+0.001	....	4501.445		

Curvature Cor. +0.0009 mm. — Mean +0.7 km.
Computed Velocity +0.6

a ARIETIS

The plate of *a Arietis* given below was previously published in Frost's paper on the Bruce spectrograph[15] as an example of the method of reduction.

a ARIETIS—B 233

1901, November 15, G. M. T. $14^h\ 36^m$ — Measured by A.
Hour angle E $1^h\ 40^m$ — Star good; comparison strong. — Power 21

S 28.0279	4442.418	....	+0.015	4442.510	−0.077	−5.2
S 28.1850	4443.880	....	+0.015	4443.976	−0.081	5.5
Ti 28.1937	4443.961	+0.015	....	4443.976		
S 28.6055	4447.808	....	+0.004	4447.892	−0.080	5.4
Ti 28.7659	Standard	±0.000	....	4449.313		
S 29.0187	4451.691	....	−0.001	4451.752	−0.062	4.2
Ti 29.6436	4457.604	−0.004	....	4457.600		
S 30.7931	4468.614	....	−0.004	4468.663	−0.053	3.6
Ti 30.7987	4468.667	−0.004	....	4468.663		
S 31.5695	4476.148	....	+0.003	4476.214	−0.063	4.2
Ti 32.1089	4481.431	+0.007	....	4481.438		
S 32.4972	4482.300	....	+0.006	4482.376	−0.070	4.7
Ti 32.8241	4488.497	−0.004	....	4488.493		
S 33.4467	4494.705	....	−0.016	4494.738	−0.049	3.3
Ti 33.6095	4496.337	−0.019	....	4496.318		
S 34.1050	4501.329	....	−0.003	4501.422	−0.096	6.4
Ti 34.1168	4501.448	−0.003	....	4501.445		
S 35.2379	4512.873	....	−0.014	4512.906	−0.047	3.1
Ti 35.2425	4512.920	−0.014	....	4512.906		
S 35.4846	4515.411	....	−0.012	4515.475	−0.076	5.1
Ti 36.6468	Standard	±0.000	....	4527.490		
S 36.7676	4528.757	....	−0.006	4528.798	−0.047	3.1
S 37.3481	4534.877	....	−0.033	4534.953	−0.109	7.2
Ti 37.3585	4534.986	−0.033	....	4534.953		
Ti 38.2862	4544.874	−0.010	....	4544.864		
S 38.3976	4546.071	....	−0.009	4546.129	−0.067	4.4

[15] *Astrophysical Journal*, Vol. XV (1902), pp. 1-27.

α ARIETIS—B 233—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 39.0060	4552.639	−0.007	....	4552.632		
S 39.1432	4554.128	....	−0.013	4554.211	−0.096	6.3
Ti 39.2861	4555.682	−0.020	....	4555.662		
S 40.0346	4563.876	....	−0.006	4563.939	−0.069	4.5
Ti 40.0409	4563.945	−0.006	....	4563.939		
S 40.6947	4571.177	....	−0.002	4571.275	−0.100	6.6
S 40.7752	4572.072	....	−0.002	4572.156	−0.086	5.6
Ti 40.7829	4572.158	−0.002	....	4572.156		
S 41.2421	4577.286	....	−0.007	4577.356	−0.077	5.0
S 42.3755	4590.093	....	−0.020	4590.126	−0.053	3.5
Ti 42.3801	4590.146	−0.020	....	4590.126.		
S 44.6303	4616.228	....	−0.001	4616.305	−0.078	5.1
S 44.7282	4617.383	....	±0.000	4617.452	−0.069	4.5
Ti 44.7340	Standard	±0.000	....	4617.452		

Curvature Cor. +0.0008 mm.

Mean		− 4.8
V_a	−8.91	
V_d	+0.13	
Reduction to Sun		− 8.78
Radial Velocity		− 13.6 km.

The results of other observers for this star are as follows:

Vogel	−14.5
Scheiner	−14.9
Lord	−14.0
Campbell	−14.1

α *TAURI*

Two plates of this star have been measured, both by A. Of these B 191 is slightly inferior for measurement on account of the narrowness of its star spectrum, the photograph having been taken previous to the change of windows in the occulting bar.

α TAURI—B 191

1901, September 4, G. M. T. 20ʰ 0ᵐ
Hour angle E 3ʰ 27ᵐ

Star good; comparison fair.

Measured by A. with Zeiss Comparator
Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm	t. m.	t. m.	t. m.	t. m.	t. m.	km
Ti 46.0655	Standard	±0.000	....	4457.600		
S 46.0170	4458.060	....	±0.000	4457.656	+0.404	+27.2
Ti 44.9084	4468.656	+0.007	....	4468.663		
S 44.0847	4476.633	....	−0.025	4476.214	+0.394	26.4
Ti 43.5887	4481.480	−0.042	....	4481.438		
Ti 41.5760	4501.488	−0.043	....	4501.445		
S 41.5383	4501.868	....	−0.043	4501.422	+0.403	26.8
S 40.4909	4512.508	....	−0.074	4512.063	+0.371	24.7
Ti 40.4446	4512.982	−0.076	....	4512.906		
S 40.4064	4513.373	....	−0.076	4512.906	+0.391	26.0
Ti 39.9322	4518.248	−0 050	....	4518.198		
S 39.8965	4518.616	....	−0.050	4518.198	+0.368	24.4
Ti 39.4690	4523.041	−0.067	....	4522.974		
S 39.0793	4527.097	....	−0.069	4526.644	+0.384	25.4
Ti 39.0350	4527.559	−0.069	....	4527.490		
S 38.9948	4527.979	....	−0.069	4527.518	+0.392	26.0
S 38.8704	4529.280	....	−0.064	4528.798	+0.418	27.7
S 38.4366	4533.831	....	−0.051	4533.419	+0.367	24.3
Ti 38.3261	4535.000	−0.047	....	4534.953		
Ti 37.3919	4544.921	−0.057	....	4544.864		
S 37.3562	4545.303	....	−0.057	4544.864	+0.382	25.2
S 37.2345	4546.606	....	−0.065	4546.129	+0.412	27.2
Ti 37.0099	4549.016	−0.078	....	4548.938		
S 36.9726	4549.417	....	−0.078	4548.938	+0.401	26.4

α TAURI—B 191—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S 36.8960	4550.241	....	−0.069	4549.767	+0.405	26.7
S 36.4873	4554.654	....	−0.055	4554.211	+0.388	25.6
Ti 36.3896	4555.713	−0.051	....	4555.662		
S 36.3502	4556.140	....	−0.051	4555.662	+0.427	28.1
Ti 35.6352	Standard	±0.000	....	4563.939		
S 35.4341	4566.147	....	+0.002	4565.750	+0.399	26.2
S 34.9308	4571.700	....	+0.006	4571.275	+0.431	28.3
Ti 34.8903	4572.150	+0.006	....	4572.156		
S 34.8516	4572.579	....	+0.006	4572.156	+0.429	28.1
S 32.1946	4602.620	....	−0.007	4602.183	+0.430	28.0
S 30.9806	4616.743	....	−0.014	4616.305	+0.424	27.5
Ti 30.9191	4617.466	−0.014	....	4617.452		
S 30.8819	4617.903	....	−0.014	4617.452	+0.437	28.4
Ti 30.4227	4623.321	−0.012	....	4623.279		
S 29.5666	4633.520	....	−0.035	4633.078	+0.407	26.3
S 28.0527	4651.883	....	−0.021	4651.461	+0.401	25.8
S 27.9800	4652.777	....	−0.020	4652.343	+0.414	26.7
Ti 27.6645	4656.662	−0.018	....	4656.644		
S 27.6303	4657.083	....	−0.018	4656.644	+0.421	27.1
S 27.0799	4663.910	....	−0.005	4663.481	+0.424	27.3
Ti 26.7709	Standard	±0.000	....	4667.768		

Curvature Cor. +0.0002 mm.

Mean		+26.6
V_a	+29.29	
V_d	+ 0.26	
Reduction to Sun		+29.55
Radial Velocity		+56.1 km.

α TAURI—B 275

1902, January 16, G. M. T. 16ʰ 15ᵐ
Hour angle E 0ʰ 33ᵐ

Star good; comparison good.

Measured by A.
Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
Ti 29.0002	Standard	±0.000	....	4417.884		
S 29.3656	4421.203	....	+0.015	4420.100	+1.118	+75.9
Ti 30.0248	4427.231	+0.035	....	4427.266		
S 31.0761	4436.956	....	+0.020	4435.851	+1.125	76.1
S 31.7232	4443.012	....	+0.009	4441.881	+1.140	77.0
S 31.7933	4443.671	....	+0.008	4442.510	+1.169	78.9
Ti 31.8249	4443.968	+0.008	....	4443.976		
Ti 31.9487	4445.134	....	+0.008	4443.976	+1.166	78.7
S 32.3640	4449.061	....	+0.009	4447.892	+1.178	79.4
Ti 32.3897	4449.304	+0.009	....	4449.313		
Ti 33.2583	4457.591	+0.009	....	4457.600		
S 33.6781	4461.632	....	−0.015	4460.460	+1.157	77.8
S 33.8214	4463.017	....	−0.024	4461.818	+1.175	79.0
Ti 33.9900	4464.650	−0.033	....	4464.617		
S 34.3228	4467.883	....	−0.009	4466.701	+1.173	78.7
Ti 34.4032	4468.667	−0.004	....	4468.663		
S 35.2905	4477.372	....	−0.001	4476.214	+1.157	77.5
Ti 35.7012	Standard	±0.000	....	4481.438		
S 35.9172	4483.586	....	−0.007	4482.376	+1.203	80.5
Ti 36.4875	4489.288	−0.026	....	4489.262		
S 36.6679	4491.101	....	−0.030	4489.911	+1.160	77.5
Ti 37.6928	4501.490	−0.045	....	4501.445		
S 37.8038	4502.624	....	−0.045	4501.422	+1.157	77.1
S 38.1535	4506.209	....	−0.030	4505.003	+1.176	78.3
Ti 38.8029	4512.914	−0.008	....	4512.906		
S 38.9166	4514.094	....	−0.008	4512.906	+1.180	78.4
Ti 40.1942	Standard	±0.000	....	4527.490		
S 40.2266	4527.833	....	±0.000	4526.644	+1.189	78.8
S 40.4312	4530.002	....	±0.000	4528.798	+1.204	79.7

Curvature Cor. +0.0008 mm.

Mean		+78.1
V_a	−22.16	
V_d	+ 0.04	
Reduction to Sun		−22.12
Radial Velocity		+56.0 km.

SUMMARY OF MEASURES OF *a TAURI*

Plate	Date	Adams	No. of Lines
B 191	1901, Sept. 4	+56.1	27
B 275	1902, Jan. 16	+56.0	16
	Mean	+56.1 km.	

The results of other observers for this star are as follows:

Vogel - - - - - - - - -	+47.6
Scheiner - - - - - - - -	+49.4
Keeler (visual) - - - - - -	+55.2
Campbell - - - - - - - -	+54.8

a BOÖTIS

Eight plates of this star have been measured, six by A. and four by F., giving results in good agreement. The plates are nearly all of excellent quality, with those of Series B somewhat superior for purposes of measurement.

a BOÖTIS—B 293

1902, March 12, G. M. T. $18^h 13^m$
Hour angle E $2^h 28^m$

Star good; comparison good.

Measured by A.
Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 29.4878	Standard	±0.000	....	4427.266		
S 29.6177	4428.456	....	+0.001	4428.711	−0.254	−17.2
S 30.3878	4435.554	....	+0.008	4435.851	−0.289	19.5
S 31.0376	4441.602	....	+0.015	4441.881	−0.264	17.8
S 31.1051	4442.234	....	+0.015	4442.510	−0.261	17.6
S 31.2619	4443.702	....	+0.017	4443.976	−0.257	17.3
Ti 31.2893	4443.959	+0.017	....	4443.976		
S 31.6819	4447.652	....	−0.001	4447.892	−0.241	16.2
Ti 31.8588	4449.323	−0.010	....	4449.313		
S 32.0882	4451.495	....	−0.006	4451.752	−0.263	17.7
Ti 32.7282	4457.592	+0.008	....	4457.600		
S 32.9457	4459.676	....	+0.006	4459.922	−0.240	16.1
S 33.6462	4466.432	....	+0.001	4466.701	−0.268	18.0
S 33.8510	4468.420	....	±0.000	4468.663	−0.243	16.3
Ti 33.8760	Standard	±0.000	....	4468.663		
S 34.6232	4475.966	....	−0.004	4476.214	−0.252	16.9
Ti 35.1786	4481.444	−0.006	....	4481.438		
S 35.2997	4482.644	....	−0.005	4482.904	−0.265	17.7
S 36.4837	4494.487	....	±0.000	4494.738	−0.251	16.8
S 36.7112	4496.786	....	+0.001	4497.046	−0.259	17.3
S 37.1419	4501.158	....	+0.003	4501.422	−0.261	17.4
Ti 37.1698	4501.442	+0.003	....	4501.445		
S 38.2623	4512.657	....	−0.020	4512.906	−0.269	17.9
Ti 38.2883	4512.926	−0.020	....	4512.906		
S 38.7248	4517.458	....	−0.011	4517.702	−0.255	16.9
S 38.7700	4517.930	....	−0.009	4518.198	−0.277	18.4
Ti 38.7966	4518.207	−0.009	....	4518.198		
Ti 39.2524	4522.975	−0.001	....	4522.974		
Ti 39.6814	Standard	±0.000	....	4527.490		
S 39.7821	4528.556	....	−0.005	4528.798	−0.247	16.4
S 40.2876	4533.923	....	−0.029	4534.168	−0.274	18.1
Ti 40.3106	4534.168	−0.029	....	4534.139		
S 40.3596	4534.691	....	−0.025	4534.953	−0.287	19.0
Ti 40.3865	4534.978	−0.025	....	4534.953		

Curvature Cor. +0.0008 mm.

Mean		−17.4
	V_a +13.63	
	V_d + 0.19	
Reduction to Sun		+13.82
Radial Velocity		− 3.6 km.

α BOÖTIS—B 300

1902, March 13, G. M. T. $17^h 29^m$ | Measured by A.
Hour angle E $3^h 12^m$ | Star good; comparison good. | Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 30.4335	Standard	±0.000	....	4427.266		
S 31.0758	4433.163	....	−0.001	4433.390	−0.228	−15.4
S 31.9839	4441.589	....	−0.002	4441.881	−0.294	19.9
S 32.0515	4442.221	....	−0.002	4442.510	−0.291	19.6
S 32.2103	4443.706	....	−0.002	4443.976	−0.272	18.4
Ti 32.2393	4443.978	−0.002	....	4443.976		
S 32.6271	4447.621	....	−0.008	4447.892	−0.279	18.8
Ti 32.8077	4449.324	−0.011	....	4449.313		
Ti 33.6773	4457.584	+0.016	....	4457.600		
S 33.8967	4459.684	....	+0.013	4459.922	−0.225	15.1
S 34.0911	4461.552	....	+0.010	4461.818	−0.256	17.2
S 34.6004	4466.461	....	+0.003	4466.701	−0.237	15.9
S 34.8012	4468.408	....	±0.000	4468.663	−0.255	17.1
Ti 34.8275	Standard	±0.000	....	4468.663		
S 35.5739	4475.948	....	−0.009	4476.214	−0.275	18.4
Ti 36.1330	4481.454	−0.016	....	4481.438		
S 36.2010	4482.127	....	−0.016	4482.376	−0.265	17.7
S 37.4367	4494.464	....	−0.020	4494.738	−0.294	19.6
Ti 37.6226	4496.339	−0.021	....	4496.318		
S 37.6675	4496.793	....	−0.021	4497.016	−0.274	18.3
S 38.0972	4501.148	....	−0.005	4501.422	−0.279	18.6
Ti 38.1269	4501.450	−0.005	....	4501.445		
S 39.2206	4512.661	....	+0.004	4512.906	−0.241	16.0
Ti 39.2440	4512.902	+0.004	....	4512.906		
S 39.7279	4517.921	....	−0.009	4518.198	−0.288	19.0
Ti 39.7554	4518.207	−0.009	....	4518.198		
S 40.5344	4526.362	....	−0.001	4526.644	−0.283	18.8
Ti 40.6414	Standard	±0.000	....	4527.490		
S 40.7409	4528.540	....	±0.000	4528.798	−0.258	17.1

Curvature Cor. +0.0008 mm.

Mean		−17.8
V_a	+13.26	
V_d	+ 0.24	
Reduction to Sun		+13.50
Radial Velocity		− 4.3 km.

α BOÖTIS—B 300

Measured by F.
Power 23

Ti 30.1742	Standard	±0.000	....	4427.266		
S 30.1583	4427.120	....	±0.000	4427.420	−0.300	−20.3
S 30.8809	4433.757	....	+0.015	4434.021	−0.249	16.8
Ti 30.9236	4434.152	+0.016	....	4434.168		
S 31.7920	4442.218	....	−0.002	4442.510	−0.294	19.8
Ti 31.9804	4443.981	−0.005	....	4443.976		
S 32.3657	4447.600	....	−0.022	4447.892	−0.314	21.2
Ti 32.5506	4449.343	−0.030	....	4449.313		
Ti 33.1993	4455.495	−0.010	....	4455.485		
S 33.2254	4455.729	....	−0.015	4456.030	−0.301	20.3
Ti 33.4195	4457.596	+0.004	....	4457.600		
Ti 34.2930	4465.991	−0.016	....	4465.975		
S 34.5436	4468.418	....	−0.011	4468.663	−0.256	17.2
Ti 34.5699	4468.674	−0.011	....	4468.663		
Ti 34.8509	4471.406	+0.002	....	4471.408		
S 34.8675	4471.568	....	−0.004	4471.846	−0.282	18.9
S 35.3133	4475.927	....	−0.002	4476.214	−0.289	19.4
Ti 35.8734	Standard	±0.000	....	4481.438		
S 35.9402	4482.101	....	±0.000	4482.376	−0.275	18.4
S 37.1760	4494.433	....	+0.004	4494.738	−0.301	20.1
Ti 37.3625	4496.313	+0.005	....	4496.318		
S 37.7462	4500.196	....	+0.007	4500.451	−0.248	16.5

α *BOÖTIS*—B 300—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S 39.4258	4517.444	....	+0.016	4517.702	−0.242	16.1
Ti 39.4968	4518.182	+0.016	....	4518.198		
S 40.2750	4526.323	....	+0.014	4526.644	−0.307	20.3
S 40.3614	4527.232	....	+0.014	4527.518	−0.272	18.0
Ti 40 3845	4527.476	+0.014	....	4527.490		
S 40.4819	4527.503	....	+0.014	4528.798	−0.281	18.6
Ti 42.0156	4544.866	−0.002	....	4544.864		
S 42.1032	4545.811	....	−0.003	4546.129	−0.314	20.7
S 42.2773	4547.695	....	−0.006	4548.024	−0.335	22.1
S 42.3632	4548.625	....	−0.008	4548.938	−0.321	21.2
Ti 42.3928	4548.946	−0.008	....	4548.938		
Ti 42.7317	Standard	±0.000	....	4552.632		
S 42.8497	4553.919	....	+0.005	4554.211	−0.287	18.9
Ti 43.0081	4555.649	+0.013	....	4555.662		

Curvature Cor. +0.0013 mm.

	Mean	−19.2
	V_a	+13.26
	V_d	+ 0.24
Reduction to Sun		+13.50
Radial Velocity		− 5.7 km.

α *BOÖTIS*—A 336

1902, March 26, G. M. T. $18^h 58^m$
Hour angle E $0^h 32^m$

Star good; comparison strong.

Measured by A.
Power 20

Ti 29.3151	Standard	±0.000	....	4427.266		
S 29.4149	4428.497	....	−0.003	4428.711	−0.217	−14.7
Ti 29.8737	4434.185	−0.017	....	4434.168		
S 30.4712	4441.664	....	−0.011	4441.881	−0.228	15.4
S 30.5237	4442.325	....	−0.011	4442.510	−0.196	13.2
S 30.6378	4443.764	....	−0.009	4443.976	−0.221	14.9
Ti 30.6553	4443.985	−0.009	....	4443.976		
S 30.9494	4447.709	....	−0.018	4447.892	−0.201	13.6
Ti 31.0772	4449.334	−0.021	....	4449.313		
S 31.2509	4451.548	....	−0.017	4451.752	−0.221	14.9
Ti 31.7235	4457.609	−0.009	....	4457.600		
S 31.9310	4460.287	....	−0.016	4460.460	−0.189	12.7
Ti 32.3716	4466.008	−0.033	....	4465.975		
S 32.4110	4466.522	....	−0.033	4466.701	−0.212	14.2
S 32.5634	4468.514	....	−0.031	4468.663	−0.183	12.3
Ti 32.5774	4468.697	−0.034	....	4468.663		
S 33.1346	4476.028	......	−0.013	4476.214	−0.199	13.3
Ti 33.5420	Standard	±0.000	....	4481.438		
S 33.6001	4482.217	....	−0.001	4482.376	−0.160	10.7
Ti 34.6475	4496.330	−0.012	....	4496.318		
·S 34.6870	4496.868	....	−0.011	4497.046	−0.189	12.6
S 35.0058	4501.224	....	−0.004	4501.422	−0.202	13.5
Ti 35.0222	4501.449	−0.004	....	4501.445		
S 36.2164	4518.013	....	−0.013	4518.198	−0.198	13.1
Ti 36.2305	4518.211	−0.013	....	4518.198		
Ti 36.8874	Standard	±0.000	....	4527.490		
S 36.9675	4528.629	....	−0.006	4528.798	−0.175	11.6
S 37.3447	4534.021	....	−0.036	4534.168	−0.183	12.1
Ti 37.3555	4534.175	−0.036	....	4534.139		
S 37.3954	4534.748	....	−0.023	4534.953	−0.228	15.1
Ti 37.4113	4534.976	−0.023	....	4534.953		

Curvature Cor. +0.0005 mm.

	Mean	−13.4
	V_a	+7.97
	V_d	+0.04
Reduction to Sun		+ 8.01
Radial Velocity		− 5.4 km.

α BOÖTIS—B 304

1902, April 2, G. M. T. $15^h 51^m$ | Measured by A.
Hour angle E $3^h 31^m$ | Power 20

Star good; comparison good.

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 30.8922	Standard	±0.000	....	4427.266		
S 31.0321	4428.551	....	±0.000	4428.711	−0.160	−10.8
S 31.8070	4435.695	....	−0.002	4435.851	−0.158	10.7
S 32.4550	4441.729	....	−0.003	4441.881	−0.155	10.5
S 32.5236	4442.371	....	−0.003	4442.510	−0.142	9.6
S 32.6807	4443.844	....	−0.004	4443.976	−0.136	9.2
Ti 32.6952	4443.980	−0.004	....	4443.976		
S 33.0958	4447.749	....	−0.007	4447.892	−0.150	10.1
S 33.2499	4449.205	....	−0.009	4449.313	−0.117	7.9
Ti 33.2623	4449.322	−0.009	....	4449.313		
Ti 34.1327	4457.603	−0.003	....	4457.600		
S 34.3622	4459.803	....	−0.002	4459.922	−0.121	8.1
S 34.5565	4461.671	....	−0.002	4461.818	−0.149	10.0
S 35.2666	4468.541	....	±0.000	4468.663	−0.122	8.2
Ti 35.2791	Standard	±0.000	....	4468.663		
S 36.0388	4476.090	....	+0.004	4476.214	−0.120	8.0
Ti 36.5803	4481.432	+0.006	....	4481.438		
S 36.6622	4482.243	....	+0.005	4482.376	−0.128	8.6
S 37.4167	4489.763	....	−0.003	4489.911	−0.151	10.1
S 37.8973	4494.595	....	−0.009	4494.738	−0.152	10.1
Ti 38.0890	4496.329	−0.011	....	4496.318		
S 38.1273	4496.919	....	−0.009	4497.046	−0.136	9.1
S 38.5563	4501.274	....	+0.001	4501.422	−0.147	9.8
Ti 38.5730	4501.444	+0.001	....	4501.445		
S 39.6769	4512.776	....	+0.004	4512.906	−0.126	8.4
Ti 39.6890	4512.902	+0.004	....	4512.906		
S 40.1840	4518.043	....	±0.000	4518.198	−0.155	10.3
Ti 40.1989	Standard	±0.000	....	4518.198		

Curvature Cor. +0.0008 mm.

Mean	−9.4
V_a	+5.04
V_d	+0.26
Reduction to Sun	+5.30
Radial Velocity	4.1 km.

α BOÖTIS—B 304

Measured by F.
Power 17

S 29.1931	4399.778	....	±0.000	4399.903	−0.125	−8.5
Ti 29.2110	Standard	±0.000	....	4399.935		
S 29.9727	4406.666	....	−0.010	4406.810	−0.154	10.5
S 30.4776	4411.165	....	−0.019	4411.240	−0.094	6.4
Ti 30.4881	4411.259	−0.019	....	4411.240		
Ti 32.2585	4427.278	−0.012	....	4427.266		
S 32.2616	4427.307	....	−0.012	4427.420	−0.125	8.5
S 33.8921	4442.402	....	−0.016	4442.510	−0.124	8.4
Ti 34.0619	4443.993	−0.017	....	4443.976		
S 34.4641	4447.780	....	−0.027	4447.892	−0.139	9.4
Ti 34.6301	4449.345	−0.032	....	4449.313		
S 34.7533	4450.511	....	−0.029	4450.597	−0.115	7.8
Ti 35.2782	4455.500	−0.015	....	4455.485		
S 35.4912	4457.535	....	−0.015	4457.656	−0.136	9.2
Ti 35.4995	4457.615	−0.015	....	4457.600		
Ti 37.9474	Standard	±0.000	....	4481.438		
S 38.0304	4482.280	....	±0.000	4482.376	−0.116	7.8
S 39.2647	4494.599	....	−0.001	4494.738	−0.140	9.3
Ti 39.4351	4496.319	−0.001	....	4496.318		
S 39.9256	4501.294	....	−0.014	4501.422	−0.142	9.5
Ti 39.9418	4501.459	−0.014	....	4501.445		
S 41.0466	4512.795	....	−0.002	4512.906	−0.113	7.5
Ti 41.0575	4512.908	−0.002	....	4512.906		
Ti 42.4516	4527.473	+0.017	....	4527.490		
S 42.5673	4528.695	....	+0.015	4528.798	−0.088	5.8

α BOÖTIS — B 304 — *Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 44.0811	4544.873	−0.009	....	4544.864		
S 44.1872	4546.020	....	−0.008	4546.129	−0.117	7.7
S 44.4471	4548.838	....	−0.005	4548.938	−0.105	6.9
S 44.9271	4554.071	....	−0.001	4554.211	−0.141	9.3
Ti 45.0724	Standard	±0.000	....	4555.662		

Mean −8.3
Curvature Cor. −0.87
V_a + 5.04
V_d + 0.26
Reduction to Sun +5.30
Radial Velocity −3.8 km.

α BOÖTIS — B 311

1902, April 3, G. M. T. 15^h 56^m — Measured by F.
Hour angle E 3^h 15^m — Star excellent; comparison excellent. — Power 17

Ti 29.2136	Standard	±0.000	....	4399.935		
S 29.1950	4399.772	....	±0.000	4399.903	−0.131	−8.9
S 29.9756	4406.664	....	−0.002	4406.810	−0.148	10.1
S 30.4744	4411.106	....	−0.004	4411.240	−0.138	9.4
Ti 30.4898	4411.244	−0.004	....	4411.240		
Ti 32.2622	4427.279	−0.013	....	4427.266		
S 32.2639	4427.286	....	−0.013	4427.420	−0.147	10.0
S 33.8967	4442.393	....	±0.000	4442.510	−0.117	7.9
Ti 34.0658	4443.976	±0.000	....	4443.976		
S 34.4718	4447.794	....	−0.017	4447.892	−0.115	7.8
Ti 34.6350	4449.334	−0.021	....	4449.313		
S 34.7568	4450.486	....	−0.018	4450.597	−0.129	8.7
Ti 35.2843	4455.496	−0.011	....	4455.485		
S 35.4991	4457.547	....	−0.008	4457.656	−0.117	7.9
Ti 35.5055	4457.608	−0.008	....	4457.600		
Ti 37.9557	Standard	±0.000	....	4481.438		
S 38.0400	4482.273	....	−0.001	4482.376	−0.104	7.0
S 39.2742	4494.602	....	−0.015	4494.738	−0.151	10.1
Ti 39.4459	4496.335	−0.017	....	4496.318		
S 39.9335	4501.277	....	−0.016	4501.422	−0.161	10.7
Ti 39.9516	4501.461	−0.016	....	4501.445		
S 41.0574	4512.800	....	+0.007	4512.906	−0.099	6.6
Ti 41.0670	4512.899	+0.007	....	4512.906		
Ti 44.0912	4544.848	+0.016	....	4544.864		
S 44.1983	4546.005	....	+0.014	4546.129	−0.110	7.3
S 44.4581	4548.820	....	+0.010	4548.938	−0.108	7.1
S 44.9415	4554.086	....	+0.002	4554.211	−0.123	8.1
Ti 45.0855	Standard	±0.000	....	4555.662		

Curvature Cor. +0.0012 mm.

Mean −8.4
V_a +4.60
V_d +0.24
Reduction to Sun +4.84
Radial Velocity −3.6 km.

α BOÖTIS — B 342

1902 May 7, G. M. T. 17^h 17^m — Measured by F.
Hour angle W 0^h 17^m — Star good; comparison good. — Power 17

Ti 30.001	Standard	±0.000	....	4427.266		
S 30.029	4427.530	....	0.000	4427.420	+0.110	+7.4
S 30.751	4431.147	....	−0.025	4434.021	+0.101	6.8
Ti 30.756	4434.193	−0.025	....	4434.168		
S 32.238	4447.981	....	−0.005	4447.892	+0.084	5.7
Ti 32.380	4449.317	−0.004	....	4449.313		

α *BOÖTIS*—B 342—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Moon Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
S 32.989	4455.075	....	−0.016	4454.993	+0.066	4.4
Ti 33.034	4455.503	−0.018	....	4455.485		
Ti 33.254	4457.596	+0.004	....	4457.600		
S 33.269	4457.740	....	+0.004	4457.656	+0.088	5.9
Ti 34.127	4465.967	+0.008	....	4465.975		
S 34.418	4468.780	....	+0.008	4468.663	+0.125	8.4
S 35.189	4476.288	....	+0.010	4476.214	+0.084	5.6
Ti 35.712	4481.427	+0.011	....	4481.438		
S 35.818	4482.473	....	+0.011	4482.376	+0 108	7.3
S 37.056	4494.809	....	+0.001	4494.738	+0.072	4.8
Ti 37.206	Standard	±0.000	....	4496.318		
S 37.716	4501.479	....	+0.002	4501.422	+0.059	3.9
S 38.844	4513.012	....	+0.006	4512.906	+0.112	7.4
Ti 40.233	4527.478	+0.012	....	4527.490		
S 40.246	4527.615	....	+0.012	4527.518	+0.109	7.2
S 40.369	4528.910	....	+0.012	4528.798	+0.124	8.2
Ti 41.865	4544.852	+0.012	....	4544.864		
S 41.992	4546.222	....	+0.010	4546.129	+0.103	6.8
S 42.736	4554.297	....	+0.001	4554.211	+0.087	5.7
Ti 42.861	Standard	±0.000	....	4555.662		

Curvature Cor. +0.001 mm.

Mean		+6.4
V_a	−9.90	
V_d	−0.03	
Reduction to Sun		−9.93
Radial Velocity		−3.6 km.

α *BOÖTIS*—B 371

1902, June 26, G. M. T. 15h 30m — Measured by A.
Hour angle W 1h 34m — Star slightly weak; comparison good. — Power 17

Ti 32.6666	Standard	±0.000	....	4427.266		
S 32.8568	4429.004	....	±0.000	4428.711	+0.293	+19.8
S 34.3503	4442.805	....	±0.000	4442.510	+0.295	19.9
Ti 34.4758	4443.976	±0.000	....	4443.976		
S 34.5112	4444.307	....	±0 000	4443.976	+0.331	22.3
S 34.9280	4448.217	....	−0.006	4447.892	+0.319	21.5
Ti 35.0452	4449.320	−0.007	....	4449.313		
Ti 35.9202	4457.613	−0.013	....	4457.600		
S 36.2514	4460.779	....	−0.009	4460.460	+0.310	20.8
Ti 37.0699	Standard	±0.000	....	4468.663		
S 37.1045	4468.998	....	±0 000	4468.663	+0 335	22.5
S 37.8768	4476.523	....	−0.013	4476.214	+0.396	19.8
Ti 38.3790	4481.460	−0.022	....	4481.438		
S 38.5036	4482.690	....	−0.023	4482.376	+0.291	19.5
Ti 39.8726	4496.348	−0.030	....	4496.318		
S 39.9741	4497.371	....	+0.024	4497.046	+0.301	20.1
Ti 40.3770	4501.447	−0.002	....	4501.445		
S 40.4046	4501.727	....	−0.002	4501.422	+0.303	20.2
Ti 41.4987	4512.917	−0.011	....	4512.906		
S 41.7730	4515.750	....	−0.009	4515.475	+0.266	17.7
Ti 42.8987	4527.492	−0.002	....	4527.490		
S 43.0539	4529.126	....	−0.001	4528.798	+0.321	21.5
Ti 44 9110	4548.964	−0.026	....	4548.938		
S 44.9386	4549.263	....	−0.026	4548.938	+0.299	19.7
S 45.4204	4554.499	....	−0.004	4554.211	+0.284	18.7
Ti 45.5269	Standard	±0.000	....	4555.662		

Curvature Cor. +0.0008 mm.

Mean		+20.3
V_a	−23.85	
V_d	− 0.13	
Reduction to Sun		−23.98
Radial Velocity		− 3.7 km.

α *BOÖTIS*—A 373

1902, September 6, G. M. T. $13^h 43^m$ — Measured by A.
Hour angle W $4^h 38^m$ — Star good; comparison good. — Power 28

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Wave-Length in Sun	Displacement	Velocity
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.
Ti 29.1810	Standard	±0.000	....	4427.266		
S 29.2066	4427.580	....	±0.000	4427.420	+0.160	+10.8
S 29.3129	4428.886	....	+0.001	4428.711	+0.176	11.9
S 29.8890	4436.008	....	+0.008	4435.851	+0.165	11.2
S 30.4227	4442.673	....	+0.014	4442.510	+0.177	11.9
Ti 30.5252	4443.961	+0.015	....	4443.976		
S 30.5392	4444.137	....	+0.015	4443.976	+0.176	11.9
S 30.8512	4448.072	....	−0.003	4447.892	+0.177	11.9
Ti 30.9499	4449.322	−0.009	....	4449.313		
Ti 31.4348	4455.494	−0.009	....	4455.485		
S 31.4904	4456.205	....	−0.008	4456.030	+0.167	11.2
Ti 32.2483	Standard	±0.000	....	4465.975		
S 32.3175	4466.874	....	±0.000	4466.701	+0.173	11.6
S 32.9524	4475.176	....	+0.005	4475.026	+0.155	10.4
S 33.0439	4476.381	....	+0.006	4476.214	+0.173	11.6
Ti 33.4257	4481.430	+0.008	....	4481.438		
S 33.5085	4482.530	....	+0.009	4482.376	+0.163	10.9
S 34.4310	4494.900	....	+0.015	4494.738	+0.177	11.8
Ti 34.5345	4496.302	+0.016	....	4496.318		
S 34.5999	4497.189	....	+0.013	4497.046	+0.156	10.4
Ti 34.9126	4501.446	−0.001	....	4501.445		
S 34.9224	4501.579	....	−0.001	4501.422	+0.156	10.4
Ti 35.7445	4512.895	+0.011	....	4512.906		
S 35.7562	4513.057	....	+0.011	4512.906	+0.162	10.8
S 35.9421	4515.642	....	+0.009	4515.475	+0.176	11.7
Ti 36.7859	Standard	±0.000	....	4527.490		
S 36.8902	4528.968	....	±0.000	4528.798	+0.170	11.3

Curvature Cor. +0.0005 mm.

Mean		+11.3
V_a	−15.79	
V_d	− 0.30	
Reduction to Sun		−16.09
Radial Velocity		− 4.8 km.

SUMMARY OF MEASURES OF α *BOÖTIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
B 293	1902, March 12	−3.6	21	.....	..
B 300	March 13	−4.3	18	−5.7	19
A 336	March 26	−5.4	17	.....	..
B 304	April 2	−4.1	18	−3.8	16
B 311	April 3	.....	..	−3.6	15
B 342	May 7	.....	..	−3.6	15
B 371	June 26	−3.7	14	.....	..
A 373	Sept. 6	−4.8	17	.....	..

Mean −4.3 −4.2

Mean of 8 plates −4.2 km.
Mean of all measures −4.3 km.

The results of other observers for this star are as follows:

Vogel and Scheiner	−7.7
Belopolsky	−5.7
Keeler (visual)	−6.8
Newall	−5.9

PLATES OF STARS OF THE *ORION* TYPE

The detailed measurements on the different plates on the *Orion* stars follow. The stars are arranged in order of right ascension, and the separate plates of the same star in chronological order. The magnitudes of the stars are from the Harvard Photometry, and the spectral classes are according to Miss Maury's classification (*Annals of Harvard College Observatory*, Vol. XXVIII, 1898). The form of tabulation is the same as for the control plates, and all necessary explanations are found in the introductory note to those plates, and in the general discussion of the method of measurement (p. 7).

1. γ *PEGASI*

(R. A. = 0^h 8^m; Dec. = $+14°$ $38'$; Mag. 3.3; Class IV*a*)

Eight plates of this star have been measured, seven by A., and five by **F.**, with four common to the two observers. As compared with the more recent plates both the stellar and comparison spectra of the earlier plates are distinctly inferior. The spectrum of this star is much better adapted to accurate measurement than that of the average star of the *Orion* type. All of the lines are comparatively narrow, and numerous oxygen and nitrogen lines are present.

γ *PEGASI*—A 215

1901, September 5, G. M. T. 21^h 28^m
Hour angle W 2^h 22^m

Star strong; comparison fair.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 25.3921	Standard	±0.000		4338.084			
S 26.4567	4349.438		−0.007	4349.541	−0.110	−7.6	1
Ti 30.5625	4395.237	−0.036		4395.201			
S 34.1140	4437.639		−0.005	4437.718	−0.084	5.7	1
Ti 34.6256	Standard	±0.000		4443.976			
Ti 35.0540	4449.327	−0.014		4449.313			
Ti 36.5711	4468.630	+0.033		4468.663			
S 36.7924	4471.493		+0.036	4471.676	−0.147	9.9	1
S 37.5336	4481.163		+0.046	4481.400	−0.191	12.8	1
Ti 37.5510	4481.392	+0.046		4481.438			
Ti 42.7055	4552.627	+0.005		4552.632			
S 42.7083	4552.668		+0.005	4552.750	−0.077	5.1	1
Ti 43.4780	Standard	±0.000		4563.939			
S 43.7430	4567.860		±0.000	4567.950	−0.090	5.9	1

Curvature Cor. +0.0001 mm.

Weighted mean		− 7.8
	V_a +11.66	
	V_d − 0.19	
Reduction to Sun		+11.47
Radial Velocity		+ 3.7 km.

Mean −7.8

γ *PEGASI*—A 218

1901, September 6, G. M. T. $17^h\ 7^m$
Hour angle E $2^h\ 20^m$

Star strong; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 23.8216	Standard	±0.000	....	4338.084	....	.....	..
S 24.0582	4340.589	....	−0.002	4340.634	−0.047	−3.2	1
S 28.3715	4388.086	....	−0.034	4388.100	−0.048	3.3	1
Ti 28.9937	4395.240	−0.039	....	4395.201	....	.....	..
S 30.6752	4414.978	....	−0.037	4415.076	−0.135	9.2	1
Ti 31.7013	4427.301	−0.035	....	4427.266	....	.....	..
S 32.5469	4437.641	....	−0.017	4437.718	−0.094	6.4	2
Ti 33.0591	4443.982	−0.006	....	4443.976	....	.....	..
Ti 33.4860	Standard	±0.000	....	4449.313	....	.....	..
S 35.2302	4471.539	....	+0.014	4471.676	−0.123	8.2	2
S 35.9751	4481.254	....	+0.021	4481.400	−0.125	8.4	3
Ti 35.9875	4481.417	+0.021	....	4481.438	....	.....	..
Ti 41.9166	Standard	±0.000	....	4563.939	....	.....	..
S 42.1850	4567.907	....	±0.000	4567.950	−0.049	3.2	2

Curvature Cor. +0.0001 mm.

Weighted mean		− 6.4
V_a	+11.29	
V_d	+ 0.17	
Reduction to Sun		+11.46
Radial velocity		+ 5.1 km.

γ *PEGASI*—A 233

1901, September 18, G. M. T. $14^h\ 50^m$
Hour angle E $3^h\ 22^m$

Star good; comparison fair.

Measured by A.
Power 21

Ti 18.6731	Standard	±0.000	....	4338.084			
S 18.9045	4340.549	....	−0.002	4340.634	−0.087	−6.0	1
S 23.1969	4388.083	....	−0.032	4388.100	−0.049	3.4	1
Ti 23.8163	4395.239	−0.038	....	4395.201			
S 25.5017	4415.111	....	−0.050	4415.076	−0.015	1.0	2
S 25.6718	4417.151	....	−0.051	4417.121	−0.021	1.4	2
Ti 25.7371	4417.935	−0.051	....	4417.884			
S 27.3544	4437.660	....	−0.010	4437.718	−0.068	4.6	2
Ti 27.8622	4443.974	+0.002	....	4443.976			
Ti 29.8037	Standard	±0.000	....	4468.663			
S 30.0261	4471.548	....	+0.004	4471.676	−0.124	8.3	1
S 30.7733	4481.330	....	+0.016	4481.400	−0.054	3.6	3
Ti 30.7803	4481.422	+0.016	....	4481.438			
Ti 35.9145	4552.542	+0.090	....	4552.632			
S 35.9204	4552.627	....	+0.090	4552.750	−0.033	2.2	2
Ti 36.6889	4563.899	+0.040	....	4563.939			
S 36.9529	4567.810	....	+0.040	4567.950	−0.100	6.6	1
Ti 37.2418	4572.115	+0.041	....	4572.156			
Ti 40.1867	Standard	±0.000	....	4617.452			
S 41.0140	4630.687	....	±0.000	4630.703	−0.016	−1.0	2

Curvature Cor. +0.0001 mm.

Weighted mean		— 3.3
V_a	+ 5.71	
V_d	+ 0.25	
Reduction to Sun		+ 5.96
Radial Velocity		+ 2.7 km.

Mean —3.8

γ *PEGASI*—A 233

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 29.999	Standard	±0.000	....	4338.084			
S 30.236	4340.613	....	−0.001	4340.634	−0.022	−1.5	1
Ti 35.551	4399.987	−0.052	....	4399.935			
S 36.829	4415.102	....	−0.054	4415.076	−0.028	−1.9	2
S 36.709	4417.175	....	−0.054	4417.121	0.000	0.0	2
Ti 37.065	4417.938	−0.054	....	4417.884			
Ti 37.839	4427.303	−0.037	....	4427.266			
S 38.684	4437.684	....	−0.029	4437.718	−0.063	−4.3	2
Ti 39.192	4444.001	−0.025	....	4443.976			
Ti 41.133	4468.680	−0.017	....	4468.663			
S 41.359	4471.609	....	−0.014	4471.676	−0.081	−5.4	3
Ti 42.110	Standard	±0.000	....	4481.438			
S 42.102	4481.335	....	±0.000	4481.400	−0.065	−4.4	3
Ti 47.245	4552.592	+0.040	....	4552.632			
S 47.252	4552.690	....	+0.040	4552.750	−0.020	−1.3	2
Ti 48.018	4563.930	+0.009	....	4563.939			
S 48.284	4567.872	....	+0.006	4567.950	−0.072	−4.7	2
Ti 48.571	Standard	±0.000	....	4572.156			

Weighted mean —3.3 Mean—2.9
Curvature Cor. —0.24

V_a +5.71
V_d +0.25

Reduction to Sun +5.96
Radial Velocity +2.5 km.

γ *PEGASI*—A 245

1902, September 26, G. M. T. 14h 5m
Hour angle E 3h 38m

Star fair; comparison strong.

Measured by A
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 32.3644	4386.958	+0.049	....	4387.007			
S 32.4662	4388.125	....	+0.042	4388.100	+0.067	+4.6	1
Ti 33.4861	Standard	±0.000	....	4399.935			
S 34.7662	4415.061	....	−0.016	4415.076	−0.031	−2.1	1
S 34.9382	4417.119	....	−0.018	4417.121	−0.020	−1.4	1
Ti 35.0036	4417.903	−0.019	....	4417.884			
He 39.3113	4471.661	+0.015	....	4471.676			
S 39.3137	4471.692	....	+0.015	4471.676	+0.031	+2.1	1
S 40.0624	4481.476	....	−0.040	4481.400	+0.036	+2.4	3
Ti 40.0625	4481.478	−0.040	....	4481.438			
Ti 43.4488	Standard	±0.000	....	4527.490			
Ti 45.2404	4552.632	±0.000	....	4552.632			
S 45.2491	4552.759	....	±0.000	4552.750	+0.009	+0.6	2
Ti 45.9822	4563.923	+0.016	....	4563.939			
S 46.2587	4568.010	....	+0.003	4567.950	+0.063	+4.1	2
Ti 46.5383	4572.165	−0.009	....	4572.156			
S 46.7283	4575.002	....	−0.008	4574.900	+0.094	+6.2	1
Ti 49.4881	Standard	±0.000	....	4617.452			

Curvature Cor. +0.0001 mm. Weighted mean +2.1 Mean +2.1

V_a +1.80
V_d +0.27

Reduction to Sun +2.07
Radial Velocity +4.2 km.

1901, October 16, G. M. T. 12ʰ 46ᵐ — *γ PEGASI*—B 194 — Measured by F.
Hour angle W 2ʰ 20ᵐ — Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.834	Standard	±0.000	....	4338.084			
S 22.178	4340.812	....	−0.002	4340.634	+0.176	+12.2	1
S 27.956	4388.406	....	−0.063	4388.100	+0.243	16.6	3
Ti 28.756	4395.274	−0.073	....	4395.201			
Ti 29.305	4400.038	−0.100	....	4399.935			
S 31.052	4415.399	....	−0.084	4415.076	+0.239	16.2	2
S 31.285	4417.480	....	−0.082	4417.121	+0.277	18.8	2
Ti 31.340	4417.966	−0.082	....	4417.884			
Ti 32.384	4427.361	−0.095	....	4427.266			
S 33.550	4438.004	....	−0.075	4437.718	+0.211	14.3	3
Ti 34.203	4444.037	−0.061	....	4443.976			
Ti 36.816	4468.721	−0.058	....	4468.663			
He 37.118	4471.636	+0.040	....	4471.676			
S 37.158	4472.018	....	−0.052	4471.676	+0.290	19.4	4
Ti 38.130	4481.472	−0.034	....	4481.438			
S 38.142	4481.595	....	−0.034	4481.400	+0.161	10.8	5
Ti 41.270	Standard	±0.000	....	4512.906			
Ti 42.680	4527.471	+0.019	....	4527.490			
Ti 45.045	4552.591	+0.041	....	4552.632			
S 45.077	4552.936	....	+0.041	4552.750	+0.227	15.0	4
Ti 46.085	4563.911	+0.028	......	4563.939			
S 46.471	4568.156	....	+0.034	4567.950	+0.240	15.8	3
Ti 46.829	4572.116	+0.040	....	4572.156			
S 47.091	4575.026	....	+0.039	4574.900	+0.200	13.1	2
Ti 48.431	4590.091	+0.035	....	4590.126			
S 48.532	4591.233	....	+0.036	4591.066	+0.203	13.3	
S 49.002	4596.602	....	+0.040	4596.291	+0.351	22.9	3
Ti 50.793	4617.392	+0.060	....	4617.452			
S 51.926	4630.844	....	+0.051	4630.703	+0.192	12.1	1
S 53.466	4649.493	....	+0.038	4649.250	+0.281	18.1	3
Ti 54.044	4656.610	+0.034	....	4656.644			
S 54.478	4661.990	....	+0.032	4661.728	+0.294	18.9	4
Ti 54.938	4667.739	+0.029	....	4667.768			
Ti 56.071	Standard	±0.000	....	4682.088			
He 58.478	4713.414	−0.162	....	4713.308			
S 58.496	4713.659	....	−0.162	4713.308	+0.245	15.6	5

Weighted mean + 16.30 — Mean + 15.8
Curvature Cor. — 0.27

V_a — 8.21
V_d — 0.19

Reduction to Sun — 8.40
Radial Velocity + 7.6 km.

γ PEGASI—B 246

1901, November 27, G. M. T. 12ʰ 11ᵐ — Measured by A.
Hour angle E 1ʰ 27ᵐ — Star good ; comparison good. — Power 21

Ti 24.2438	Standard	±0.000	....	4387.007			
S 24.4247	4388.571	....	±0.000	4388.100	+0.471	+32.2	2
Ti 26.9971	4411.222	+0.018	....	4411.240			
S 27.4696	4415.466	....	+0.016	4415.076	+0.406	27.6	3
Ti 33.1500	4468.669	−0.006	......	4468.663			
S 33.5051	4472.134	....	−0.004	4471.676	+0.454	30.4	2
Ti 34.4500	Standard	±0.000	....	4481.438			
S 34.4929	4481.863	....	±0.000	4481.400	+0.463	31.0	2
Ti 41.2867	4552.593	+0.039	....	4552.632			
S 41.3428	4553.206	....	+0.039	4552.750	+0.495	32.6	2
Ti 42.3138	4563.903	+0.036	....	4563.939			
S 42.7187	4568.410	....	+0.019	4567.950	+0.479	31.4	3
Ti 43.0535	Standard	±0.000	....	4572.156			

Curvature Cor. + 0.0008 mm. — Weighted mean + 30.7 — Mean + 30.9

V_a — 24.93
V_d + 0.12

Reduction to Sun — 24.81
Radial Velocity + 5.9 km.

γ *PEGASI*—B 246

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 29.961	4367.455	....	+0.057	4367.012	+0.500	+34.3	1
Ti 30.000	4367.782	+0.057	....	4367.839			
Ti 32.259	Standard	+0.001	....	4387.007			
S 32.440	4388.571	....	−0.001	4388.100	+0.470	32.1	2
S 35.489	4415.497	....	−0.042	4415.076	+0.379	25.7	3
Ti 35.759	4417.934	−0.050	....	4417.884			
Ti 37.534	4434.182	−0.014	....	4434.168			
S 37.972	4438.251	....	−0.029	4437.718	+0.504	34.1	2
Ti 38.219	4440.551	−0.036	....	4440.515			
Ti 40.892	4465.998	−0.023	....	4465.975			
Ti 41.451	4471.439	−0.031	....	4471.408			
S 41.532	4472.231	....	−0.019	4471.676	+0.536	35.9	2
Ti 42.467	Standard	+0.001	....	4481.438			
S 42.514	4481.902	....	+0.001	4481.400	+0.503	33.7	3
Ti 49.306	4552.612	+0.020	....	4552.632			
S 49.362	4553.241	....	+0.017	4552.750	+0.491	32.3	2
Ti 49.584	4555.656	+0.005	....	4555.662			
Ti 52.654	Standard	+0.001	....	4590.126			
S 52.789	4591.682		±0.000	4591.066	+0.616	40.2	1

Weighted mean +32.6 Mean +33.5
Curvature Cor. − 0.90

V_a −24.93
V_d + 0.12

Reduction to Sun −24.81
Radial Velocity + 6.9 km.

γ *PEGASI*—B 395

1902, August 22, G. M. T. $20^h\ 40^m$
Hour angle W $0^h\ 40^m$

Star good; comparison good.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 25.3176	4387.943	....	±0.000	4388.100	−0.157	−10.7	1
Ti 26.1587	Standard	±0.000		4395.201			
S 28.3946	4414.893	....	−0.024	4415.076	−0.207	14.2	2
S 28.6302	4417.002	....	−0.027	4417.121	−0.146	9.9	1
Ti 28.7316	4417.912	−0.028	....	4417.884			
Ti 29.7690	4427.301	−0.035	....	4427.266			
S 30.8940	4437.613	....	−0.002	4437.718	−0.107	7.2	1
Ti 31.5778	4443.961	+0.012	....	4443.976			
Ti 34.1776	Standard	±0.000	....	4468.663			
S 34.4670	4471.468	....	+0.003	4471.676	−0.205	13.8	2
S 35.4614	4481.192	....	+0.015	4481.400	−0.193	12.9	3
Ti 35.4849	4481.423	+0.015	....	4481.438			
S 42.3591	4552.566	....	+0.013	4552.750	−0.171	11.3	3
Ti 42.3640	4552.619	+0.013	....	4552.632			
Ti 43.3973	4563.942	−0.003	....	4563.939			
S 43.7499	4567.816	....	−0.002	4567.950	−0.106	7.0	2
Ti 44.1371	Standard	±0.000	....	4572.156			
S 44.3630	4574.682	....	±0.000	4574.900	−0.218	14.3	2

Curvature Cor. +0.0009 mm. Weighted mean −11.6 Mean −11.2

V_a +17.60
V_d − 0.06

Reduction to Sun +17.54
Radial Velocity + 5.9 km.

γ *PEGASI*—B 395

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 30.0036	4338.093	−0.009	....	4338.084			
S 30.2982	4340.438	....	−0.006	4340.634	−0.202	−14.0	2
Cr 30.8273	Standard	±0.000	....	4344.670			
Cr 34.0985	4371.478	−0.036	....	4371.442			
S 36.0509	4388.025	....	−0.038	4388.100	−0.113	7.7	3
Ti 36.8869	4395.240	−0.039	....	4395.201			
S 39.1255	4414.957	....	−0.059	4415.076	−0.178	12.1	2
Ti 39.4590	4417.945	−0 061	....	4417.884			
Ti 40.4960	4427.321	−0.055	....	4427.266			
S 41.6236	4437.667	....	−0.049	4437.718	−0.100	6.8	3
Ti 42.3077	4444.021	−0.045	....	4443.976			
Ti 44.9038	4468.682	−0.019	....	4468.663			
S 45.1978	4471.531	....	−0.015	4471.676	−0.160	10.7	3
S 46.1916	4481.246	....	±0.000	4481.400	−0.154	10.3	4
Ti 46.2109	Standard	±0.000	....	4481.438			
S 53.0861	4552.573	....	+0.007	4552.750	−0.170	11.2	3
Ti 53.0909	4552.625	+0.007	......	4552.632			
Ti 53.3687	4555.651	+0.011	....	4555.662			
Ti 54.1247	4563.949	−0.010	....	4563.939			
S 54.4745	4567.820	....	±0.000	4567.950	−0.130	8.5	3
Ti 54.8641	Standard	±0.000	....	4572.156			
S 55.0962	4574.750	....	±0.000	4574.900	−0.150	9.8	2

Weighted mean — 9.9 Mean —10.1
Curvature Cor. — 0.82

V_a +17.60
V_d — 0.06

Reduction to Sun +17.54
Radial Velocity + 6.8 km.

1902, October 9, G. M. T. 17^h 53^m
Hour angle W. 1^h 5^m

γ *PEGASI*—B 419

Star good; comparison good.

Measured by A.
Power 21

Ti 22.0428	Standard	±0.000	....	4338.084			
S 22.3850	4340.812	....	−0.001	4340.634	+0.177	+12.2	1
S 28.1141	4388.306	....	−0.014	4388.100	+0.192	13.1	1
Ti 28.9134	4395.217	−0.016	....	4395.201			
Ti 29.4541	4399.935	±0.000	....	4399.935			
S 31.1782	4415.206	....	−0.006	4415.076	+0.124	8.4	2
S 31.4124	4417.308	....	−0.007	4417.121	+0.180	12.2	1
Ti 31.4773	4417.891	−0.007	....	4417.884			
Ti 32.5113	4427.258	+0.008	....	4427.266			
S 33.6671	4437.885	....	+0.003	4437.718	+0.170	11.5	2
Ti 34.3214	Standard	±0.000	....	4443.976			
Ti 36.9141	4468.657	+0.006	....	4468.663			
S 37.2371	4471.795	....	+0.012	4471.676	+0.131	8.8	3
Ti 38.2175	4481.406	+0.032	....	4481.438			
S 38.2291	4481.521	....	+0.032	4481.400	+0.153	10.2	5
Ti 45.0835	4552.625	+0.007	....	4552.632			
S 45.1120	4552.935	....	+0.007	4552.750	+0.192	12.6	2
Ti 46.1136	Standard	±0.000	....	4563.939			
S 46.4929	4568.149	....	−0.008	4567.950	+0.191	12.5	4
Ti 46.8533	4572.172	−0.016	....	4572.156			

Curvature Cor. +0.0008 mm. Weighted mean +11.0 Mean+11.3

V_a — 4.63
V_d — 0.09

Reduction to Sun — 4.72
Radial Velocity + 6.3 km.

γ *PEGASI*—B 419

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 29.9510	4387.035	−0.028	....	4387.007			
S 30.0991	4388.309	....	−0.025	4388.100	+0.184	+12.6	1
Ti 30.8962	4395.207	−0.006	....	4395.201			
Ti 31.4378	Standard	±0.000	....	4399.935			
S 33.1676	4415.266	....	−0.003	4415.076	+0.187	12.7	2
Ti 33.4584	4417.878	+0.006	....	4417.884			
Ti 34.4958	4427.279	−0.013	....	4427.266			
S 35.6534	4437.925	....	−0.004	4437.718	+0.203	13.7	1½
Ti 36.3037	4443.980	−0.004	....	4443.976			
Ti 38.8970	4468.667	−0.004	....	4468.663			
Ti 39.1795	4471.410	−0.002	....	4471.408			
S 39.2222	4471.825	....	−0.002	4471.676	+0.147	9.9	2½
Ti 40.2030	Standard	±0.000	....	4481.438			
S 40.2149	4481.556	....	±0.000	4481.400	+0.156	10.4	3
Ti 47.0704	4552.625	+0.007	....	4552.632			
S 47.0981	4552.926	....	+0.007	4552.750	+0.183	12.0	2
Ti 48.1009	4563.931	+0.008	....	4563.939			
S 48.4826	4568.163	....	+0.001	4567.950	+0.217	14.2	2
Ti 48.8408	Standard	±0.000	....	4572.156			
S 49.1044	4575.108	....	+0.001	4574.900	+0.209	13.7	1
Ti 50.4284	4590.113	+0.013	....	4590.126			

Curvature Cor. +0.0013 mm.

Weighted mean		+12.0
V_a	−4.63	
V_d	−0.09	
Reduction to Sun		− 4.72
Radial Velocity		+ 7.3 km.

Mean +12.4

SUMMARY OF MEASURES OF γ *PEGASI*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 215	1901, Sept. 5	+3.7	6	.....	..
A 218	Sept. 6	+5.1	7	.....	..
A 233	Sept. 18	+2.7	10	+2.5	8
A 245	Sept. 26	+4.2	8	.....	..
B 194	Oct. 16	.....	..	+7.6	16
B 246	Nov. 27	+5.9	6	+6.9	8
B 395	1902, Aug. 22	+5.9	9	+6.8	9
B 419	Oct. 9	+6.3	9	+7.3	8

Mean +4.8 +6.2

Mean of 8 plates +5.3 km.
Mean of all measures +5.4 km.

2. ζ *CASSIOPEIAE*

(R. A. = 0^h 31^m; Dec. = +53° 21′; Mag. 3.7; Class IV*a*)

Four plates of this star have been measured, with two common to the two observers. The spectrum has much the same lines as in the case of γ *Pegasi*, but the lines are considerably broader, and accurate measurement is consequently more difficult.

1901, October 31, G. M. T. 13ʰ 50ᵐ
Hour angle E 0ʰ 20ᵐ

ζ CASSIOPEIAE—A 281

Star fair; comparison fair.

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 29.4825	4338.046	+0.038	....	4338.084			
S 29.7341	4340.725	....	+0.038	4340.634	+0.129	+8.9	1
Ti 30.0789	4344.414	+0.037	....	4344.451			
S 32.1530	4367.070	....	+0.001	4367.012	+0.059	+4.0	½
Ti 32.2221	Standard	±0.000	....	4367.839			
Ti 33.9222	4387.046	−0.039	....	4387.007			
He 34.0167	4388.131	−0.031	....	4388.100			
S 34.0234	4388.208	....	−0.036	4388.100	+0.072	+4.9	2
Ti 35.4240	4404.496	−0.063	....	4404.433			
S 36.3179	4415.105	....	−0.072	4415.076	−0.043	−2.9	2
Ti 36.5559	4417.958	−0.074	....	4417.884			
Ti 37.8895	4434.174	−0.006	....	4434.168			
S 38.1825	4437.790	....	+0.001	4437.718	+0.073	+4.9	1½
Ti 38.4019	4440.510	+0.005	....	4440.515			
Ti 40.4150	4465.983	−0.008	....	4465.975			
S 40.8538	4471.663	....	−0.005	4471.676	−0.018	−1.2	3
Ti 41.6007	Standard	±0.000	....	4481.438			
S 41.6002	4481.431	....	±0.000	4481.400	+0.031	+2.1	4
Ti 46.7395	4552.599	+0.033	....	4552.632			
S 46.7538	4552.807	....	+0.033	4552.750	+0.090	+5.9	2
Ti 46.9467	4555.620	+0.042	....	4555.662			
Ti 47.5099	4563.894	+0.045	....	4563.939			
S 47.7895	4568.036	....	+0.038	4567.950	+0.124	+8.1	1
Ti 49.2547	Standard	±0.000	....	4590.126			
Ti 51.7687	Standard	±0.000	....	4629.521			
S 51.8431	4630.717	....	±0.000	4630.703	+0.014	+0.9	2
Ti 54.0936	Standard	±0.000	....	4667.768			
Ti 56.5594	Standard	±0.000	....	4710.368			
He 56.7282	4713.365	−0.057	....	4713.308			
S 56.7296	4713.391	....	−0.028	4713.308	+0.055	+3.5	3

Curvature Cor. +0.0009 mm.

Weighted mean +2.7 Mean +3.6

V_a −1.90
V_d +0.02

Reduction to Sun −1.88
Radial Velocity +0.8 km.

1901, November 7, G. M. T. 14ʰ 43ᵐ
Hour angle E 0ʰ 43ᵐ

ζ CASSIOPEIAE—B 211

Star good; comparison on but one side of star spectrum.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 19.3141	Standard	±0.000	....	4338.084			
Ti 25.2765	4387.103	−0.096	....	4387.007			
S 25.4128	4388.268	....	−0.094	4388.100	+0.074	+5.1	2
S 30.9939	4437.819	....	−0.010	4437.718	+0.091	6.2	1
Ti 31.6579	Standard	±0.000	....	4443.976			
Ti 34.2661	4468.670	−0.007	....	4468.663			
S 34.5904	4471.803	....	±0.000	4471.676	+0.127	8.5	3
Ti 35.5771	4481.413	+0.025	....	4481.438			
S 35.5847	4481.497	....	+0.025	4481.400	+0.122	8.2	2
Ti 42.4790	4552.614	+0.018	....	4552.632			
S 42.5045	4552.890	....	+0.018	4552.750	+0.158	10.4	2
Ti 43.5160	Standard	±0.000	....	4563.939			
S 43.8931	4568.101	....	±0.000	4567.750	+0.151	9.9	1
Ti 44.2586	4572.157	−0.001	....	4572.156			
S 44.5133	4574.996	....	−0.001	4574.900	+0.095	6.2	1

Curvature Cor. +0.0002 mm.

Weighted mean +9.7 Mean +7.8

V_a −4.48
V_d +0.04

Reduction to Sun −4.44
Radial Velocity +3.5 km.

ζ CASSIOPEIAE—B 248

1901, November 27, G. M. T. 16^h 48^m Measured by A.
Hour angle W 2^h 49^m Star good; comparison good. Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 25.8586	Standard	±0.000	....	4387.007			
S 25.0051	4388.274	....	+0.002	4388.100	+0.176	+12.0	3
Ti 28.6093	4411.207	+0.033	....	4411.240			
S 29.2890	4417.324	....	+0.021	4417.121	+0.224	15.2	1
Ti 31.1310	4434.181	−0.013	....	4434.168			
S 31.5420	4438.000	....	±0.000	4437.718	+0.282	19.1	3
Ti 32.1785	4443.956	+0.020	....	4443.976			
Ti 34.7653	4468.700	−0.037	....	4468.663			
S 35.0971	4471.938	....	−0.028	4471.676	+0.234	15.7	2
Ti 36.0618	Standard	±0.000	....	4481.438			
S 36.0736	4481.555	....	±0.000	4481.400	+0.155	10.4	3
Ti 42.8983	4552.605	+0.027	....	4552.632			
S 42.9342	4552.998	....	+0.027	4552.750	+0.275	18.1	2
Ti 43.9288	4563.956	−0.017	....	4563.939			
S 44.3155	4568.259	....	−0.013	4567.950	+0.296	19.4	1
S 44.9318	4575.170	....	−0.010	4574.900	+0.260	17.0	1
Ti 46.2466	Standard	±0.000	....	4590.126			
S 46.8046	4596.563	....	±0.000	4596.291	+0.272	17.8	2

Curvature Cor. +0.0009 mm. Weighted mean +15.5 Mean +16.1

V_a −11.41
V_d − 0.14

Reduction to Sun −11.55
Radial Velocity + 4.0 km.

ζ CASSIOPEIAE—B 248

Measured by F.
Power 12

Ti 34.9060	4340.689	....	+0.108	4340.634	+0.163	+11.3	2
S 34.9975	4341.425	+0.105	....	4341.530			
Ti 40.4650	Standard	±0.000	....	4387.007			
S 40.6127	4388.281	....	+0.005	4388.100	+0.189	12.9	3
Ti 42.4605	4404.465	+0.032	....	4404.433			
S 43.6605	4415.187	....	+0.027	4415.076	+0.138	9.4	½
Ti 45.7405	4434.184	+0.016	....	4434.168			
S 46.1508	4437.994	....	+0.010	4437.718	+0.286	19.3	1
Ti 49.0985	4466.007	−0.032	....	4465.975			
S 49.7048	4471.911	....	−0.022	4471.676	+0.213	14.3	3
Ti 50.6725	Standard	±0.000	....	4481.438			
S 50.6848	4481.560	....	±0.000	4481.400	+0.160	10.7	4
Ti 57.5090	4552.602	+0.030	....	4552.632			
S 57.5480	4553.028	....	+0.030	4552.750	+0.308	20.3	3
S 58.9235	4568.228	....	+0.017	4567.950	+0.195	12.8	2
Ti 60.8570	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0015 mm. Weighted mean +13.9 Mean +13.9

V_a −11.41
V_d − 0.14

Reduction to Sun −11.55
Radial Velocity + 2.4 km.

1902, July 22, G. M. T. 19h 10m
Hour angle E 3h 10m

ζ CASSIOPEIAE — A 355
Star good; comparison imperfect.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 24.1893	Standard	±0.000	....	4338.084			
S 24.4017	4340.360	....	−0.001	4340.634	−0.275	−19.5	3
S 28.6706	4387.926	....	−0.023	4388.100	−0.197	13.5	2
Ti 29.7021	4399.963	−0.028	....	4399.935			
Ti 31.9750	4427.286	−0.020	....	4427.266			
Ti 33.3186	Standard	±0.000	....	4443.976			
Ti 35.2474	4468.672	−0.009	....	4468.663			
S 35.4537	4471.366	....	−0.003	4471.676	−0.316	21.2	1
S 36.1905	4481.075	....	+0.019	4481.400	−0.306	20.5	2
Ti 36.2164	4481.419	+0.019	....	4481.438			
S 41.3134	4552.521	....	+0.012	4552.750	−0.217	14.3	2
Ti 41.3201	4552.620	+0.012	....	4552.632			
Ti 42.0857	4563.929	+0.010	....	4563.939			
S 42.3338	4567.631	....	+0.005	4567.950	−0.314	20.6	2
Ti 42.6353	Standard	±0.000	....	4572.156			
S 42.7960	4574.579	....	±0.000	4574.900	−0.311	20.4	1

Curvature Cor. +0.0005 mm. Weighted mean −18.1 Mean −18.5

V_a +20.77
V_d + 0.15

Reduction to Sun +20.92
Radial Velocity + 2.8 km.

ζ CASSIOPEIAE — A 355

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 28.9627	Standard	±0.000	....	4338.084			
S 29.1747	4340.355	....	0.000	4340.634	−0.279	−19.3	2
Ti 33.3655	4387.004	+0.003	....	4387.007			
S 33.4441	4387.912	....	−0.005	4388.100	−0.193	13.2	2
Ti 34.0764	4395.263	−0.062	....	4395.201			
Ti 36.7481	4427.258	+0.008	....	4427.266			
S 37.5660	4437.367	....	+0.007	4437.718	−0.344	23.2	2
Ti 38.0936	4443.970	+0.006	....	4443.976			
Ti 40.0224	Standard	±0.000	....	4468.663			
S 40.2310	4471.387	....	+0.018	4471.676	−0.271	18.2	2
S 40.9630	4481.032	....	+0.083	4481.400	−0.285	19.1	1
Ti 40.9873	4481.355	+0.083	....	4481.438			
S 46.0922	4552.570	....	+0.024	4552.750	−0.156	10.3	1½
Ti 46.0968	4552.638	+0.024	....	4552.662			
Ti 46.8620	4563.943	−0.004	....	4563.939			
S 47.1174	4567.755	....	−0.002	4567.950	−0.197	12.9	1
Ti 47.4106	Standard	±0.000	....	4572.156			
S 47.5781	4574.682	....	+0.002	4574.900	−0.216	14.2	½

Curvature Cor. + 0.0010 mm. Weighted mean −16.9 Mean −16.3

V_a +20.77
V_d + 0.15

Reduction to Sun +20.19
Radial Velocity + 4.0 km.

SUMMARY OF MEASURES OF *ζ CASSIOPEIAE*

Plate	Date	Adams	No. of lines	Frost	No. of lines
A 281	1901, Oct. 31	.....	..	+0.8	11
B 211	Nov. 7	+3.5	7	.....	..
B 248	Nov. 27	+4.0	9	+2.4	8
A 355	1902, July 22	+2.8	7	+4.0	7

Mean +3.3 +2.4

Mean of 4 plates +2.7 km.
Mean of all measures +2.9 km.

3. ε *CASSIOPEIAE*

(R. A.= 1^h 47^m; Dec.= +63° 11′; Mag. 3.6; Class IV *ab*)

Four plates of this star have been measured, all of which are common to the two observers. The spectrum contains but few lines, and these are very broad and difficult of measurement.

ε *CASSIOPEIAE* — A 261

1901, October 3, G. M. T. 17^h 15^m
Hour angle E 1^h 35^m

Star fair; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
t. m.	t. m.	t. m.	t. m.	t. m.	t. m.	km	
Ti 19.1034	Standard	±0.000	....	4338.084			
S 19.3091	4340.273	....	−0.001	4340.634	−0.362	−25.0	1
S 23.6055	4387.820	....	−0.014	4388.100	−0.294	20.1	1
Ti 24.2459	4395.218	−0.017	....	4395.201			
Ti 26.9383	Standard	±0.000	....	4427.266			
S 27.7639	4437.410	....	+0.009	4437.718	−0.299	20.2	1
Ti 28.2905	4443.962	+0.014	....	4443.976			
Ti 30.2297	4468.645	+0.018	....	4468.663			
S 30.4385	4471.357	....	+0.016	4471.676	−0.303	20.3	1
S 31.1840	4481.125	....	+0.011	4481.400	−0.264	17.7	1
Ti 32.7017	Standard	±0.000	....	4501.445			

Curvature Cor. +0.0001mm. Weighted mean −20.7 Mean −20.7

	V_a +13.49	
	V_d + 0.06	
Reduction to Sun		+13.55
Radial Velocity		− 7.1 km.

ε *CASSIOPEIAE* — A 261

Measured by F.
Power 12

Ti 30.7668	Standard	±0.000	.....	4338.084			
S 30.9890	4340.452	.....	−0.002	4340.634	−0.184	−12.7	2
S 35.2729	4387.897	.....	−0.070	4388.100	−0.273	18.7	1
Ti 35.9119	4395.281	−0.080	.....	4395.201			
Ti 36.3172	4400.008	−0.073	.....	4399.935			
Ti 41.8970	4468.711	−0.048	.....	4468.663			
S 42.1101	4471.481	.....	−0.036	4471.676	−0.231	15.5	2
Ti 42.8707	Standard	±0.000	.....	4481.438			
S 42.8461	4481.114	.....	±0.000	4481.400	−0.286	19.1	2
Ti 48.7767	4563.920	+0.019	.....	4563.939			
Ti 49.3307	Standard	±0.000	.....	4572.156			

Curvature Cor. + 0.0003 mm. Weighted mean —16.2 Mean — 16.5

	V_a +13.49	
	V_d + 0.06	
Reduction to Sun		+13.55
Radial Velocity		— 2.6 km.

ε CASSIOPEIAE—A 275

1901, October 23, G. M. T. 20h 35m
Hour angle W 3h 5m

Star rather weak; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 24.5055	Standard	±0.000	....	4338.084			
S 29.0245	4387.844	....	±0.000	4388.100	−0.256	−17.5	2
Ti 30.0703	Standard	±0.000	....	4399.935			
Ti 32.3639	4427.263	+0.003	....	4427.266			
S 33.2000	4437.514	....	+0.025	4437.718	−0.179	12.1	2
Ti 34.1426	4449.261	+0.052	....	4449.313			
Ti 35.6617	4468.633	+0.030	....	4468.663			
S 35.8816	4471.484	....	+0.023	4471.676	−0.169	11.3	4
S 36.6239	4481.194	....	±0.000	4481.400	−0.206	13.9	3
Ti 36.6424	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0002 mm.

Weighted mean		−13.3
	V_a +7.65	
	V_d − 0.11	
Reduction to Sun		+ 7.54
Radical Velocity		− 5.8 km.

Mean —13.7

ε CASSIOPEIAE—A 275

Measured by F.
Power 12

Ti 30.7013	Standard	±0.000	.....	4338.084			
S 30.9194	4340.398	.....	±0.000	4340.634	−0.236	−16.3	½
S 35.2210	4387.871	.....	+0.008	4388.100	−0.221	15.1	2
Ti 35.8565	4395.195	+0.009	.....	4395.201			
Ti 36.2644	Standard	±0.000	.....	4399.935			
Ti 41.8583	4468.647	+0.016	.....	4468.663			
S 42.0745	4471.448	.....	+0.012	4471.676	−0.216	14.5	2
S 42.8145	4481.122	.....	±0.000	4481.400	−0.278	18.6	2
Ti 42.8385	Standard	±0.000	.....	4481.438			

Curvature Cor. +0.0003 mm.

Weighted mean		−16.0
	V_a +7.65	
	V_d −0.11	
Reduction to Sun		+ 7.54
Radial Velocity		— 8.5 km.

Mean —16.1

ε CASSIOPEIAE—A 278

1901, October 25, G. M. T. 14h 8m
Hour angle E 3h 35m

Star good; comparison good.

Measured by A.
Power 25

S 23.7063	4387.867	....	−0.017	4388.100	−0.250	−17.1	1
Ti 24.3426	4395.218	−0.017	....	4395.201			
Ti 24.7471	Standard	±0.000	....	4399.935			
Ti 26.2616	4417.899	−0.015	....	4417.884			
S 27.8617	4437.417	....	−0.003	4437.718	−0.304	20.5	1
Ti 28.3891	Standard	±0.000	....	4443.976			
Ti 30.3307	4468.678	−0.015	....	4468.663			
S 30.5491	4471.513	....	−0.012	4471.676	−0.175	11.7	3
S 31.2868	4481.174	....	±0.000	4481.400	−0.226	15.1	4
Ti 31.3068	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0002 mm

Weighted mean		−14.8
	V_a +7.09	
	V_d +0.12	
Reduction to Sun		+ 7.21
Radial Velocity		— 7.6 km.

Mean —16.1

ε *CASSIOPEIAE*—A 278

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 29.3007	Standard	±0.000	.....	4338.084			
S 29.5350	4340.574	.....	±0.000	4340.634	−0.060	− 4.1	1
Ti 33.7369	4387.004	+0.003	.....	4387.007			
S 33.8060	4387.797	.....	+0.003	4388.100	−0.300	20.5	2
Ti 34.8535	Standard	±0.000	.....	4399.935			
Ti 40.4379	4468.675	−0.012	.....	4468.663			
S 40.6615	4471.579	.....	−0.009	4471.676	−0.106	7.1	2
S 41.3959	4481.204	.....	±0.000	4481.400	−0.196	13.1	2
Ti 41.4136	Standard	±0.000	.....	4481.438			

Curvature Cor. +0.0003 mm. Weighted Mean —12.2 **Mean —11.2**

V_a +7.09
V_d +0.12

Reduction to Sun + 7.21
Radial Velocity — 5.0 km.

ε *CASSIOPEIAE*—B 399

1902, August 27, G. M. T. $18^h 49^m$
Hour angle E $2^h 21^m$

Star good; comparison good.

Measured by A.
Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 20.8602	Standard	±0.000	.....	4338.084			
S 21.1412	4340.311	.....	+0.002	4340.634	−0.318	−22.0	1
S 26.8763	4387.657	.....	+0.041	4388.100	−0.399	27.3	1
Ti 27.7456	4395.150	+0.051	.....	4395.201			
Ti 28.2955	Standard	±0.000	.....	4399.935			
Ti 33.7409	4449.296	+0.017	.....	4449.313			
Ti 35.7701	4468.661	+0.002	.....	4468.663			
S 36.0427	4471.304	.....	+0.002	4471.676	−0.370	24.8	2
S 37.0402	4481.066	.....	±0.000	4481.400	−0.331	22.4	2
Ti 37.0779	Standard	±0.000	.....	4481.438			

Cuvature Cor. +0.0008 mm. Weighted mean —23.9 Mean —24.1

V_a +19.50
V_d + 0.09

Reduction to Sun +19.59
Radial Velocity — 4.3 km.

ε *CASSIOPEIAE*—B 399

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 32.8406	Standard	±0.000	.....	4468.663			
S 33.1104	4471.282	.....	±0.000	4471.676	−0.394	−26.4	2
S 34.1070	4481.030	.....	±0.000	4481.400	−0.370	24.8	2
Ti 34.1485	Standard	±0.000	.....	4481.438			
Ti 34.8623	Standard	±0.000	.....	4488.493			

Curvature Cor. +0.0012 mm. Weighted mean —25.6 Mean —25.6

V_a +19.50
V_d + 0.09

Reduction to Sun +19.59
Radial Velocity — 6.0 km.

SUMMARY OF MEASURES OF ϵ *CASSIOPEIAE*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 261	1901, Oct. 3	−7.1	5	−2.6	4
A 275	Oct. 23	−5.8	4	−8.5	4
A 278	Oct. 25	−7.6	4	−5.0	4
B 399	1902, Aug. 27	−4.3	4	−6.0	2
	Mean	−6.2		−5.5	

Mean of 4 plates −5.9 km.
Mean of all measures −5.9 km.

4. ζ *PERSEI*

(R. A. = $3^h 48^m$; Dec. = $+31° 35'$; Mag. 3.1; Class II*a*)

Five plates of this star have been measured, five by A., and two by F. The lines in this spectrum, though numerous, are extremely broad and ill defined, making accurate measurement difficult.

1901, September 12, G. M. T $18^h 4^m$
Hour angle E $4^h 6^m$

ζ *PERSEI* — A 226
Star rather weak; comparison fair.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 24.8256	4387.976	....	+0.033	4388.100	−0.091	−6.2	1
He 24.8336	4388.067	+0.033	....	4388.100			
Ti 25.4507	Standard	±0.000	....	4395.201			
S 32.4118	4481.336	....	−0.001	4481.400	−0.065	4.4	1
Ti 32.4196	4481.439	−0.001	....	4481.438			
Ti 37.3098	Standard	±0.000	....	4548.938			
Ti 38.3352	4563.915	+0.024	....	4563.939			
S 38.6014	4567.852	....	+0.018	4567.950	−0.080	5.2	3
Ti 38.8901	4572.146	+0.010	....	4572.156			
S 39.0692	4574.822	....	+0.010	4574.900	−0.068	4.5	1
Ti 41.8387	4617.445	+0.007	....	4617.452			
S 43.9076	4650.888	....	+0.002	4650.925	−0.035	2.3	1
S 44.5498	4661.564	....	+0.001	4661.728	−0.163	10.5	1
Ti 44.9191	Standard	±0.000	....	4667.768			
S 47.5475	4713.357	....	−0.113	4713.308	−0.064	4.1	2
He 47.5511	4713.421	−0.113	....	4713.308			

Curvature Cor. +0.0001 mm.   Weighted mean − 5.2   Mean −5.3

V_a +27.45
V_d + 0.26

Reduction to Sun +27.72
Radial Velocity +22.5 km.

1901, September 18, G. M. T. $18^h 26^m$
Hour angle E $3^h 28^m$

ζ *PERSEI* — A 235
Star good; comparison good.

Measured by A
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 31.2357	4388.036	....	±0.000	4388.100	−0.064	−4.4	1
Ti 31.8557	Standard	±0.000	....	4395.201			
S 33.5371	4415.034	....	−0.023	4415.076	−0.065	−4.4	3
S 33.7142	4417.157	....	−0.025	4417.121	+0.011	+0.8	2
Ti 33.7768	4417.910	−0.026	....	4417.884			
Ti 37.8433	Standard	±0.000	....	4468.663			
S 38.0673	4471.571	....	±0.000	4471.676	−0.105	−7.0	2
Ti 45.2786	Standard	±0.000	....	4572.156			
S 45.4611	4574.890	....	±0.000	4574.900	−0.010	−0.6	1

Curvature Cor. +0.0002 mm.   Weighted mean − 3.4   Mean −3.1

V_a +26.38
V_d + 0.23

Reduction to Sun +26.61
Radial Velocity +23.2 km.

ζ PERSEI — B 218

1901, November 8, G. M. T. 16ʰ 33ᵐ
Hour angle E 1ʰ 55ᵐ

Star fair; comparison fair.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 20.3486	Standard	±0.000	....	4338.084			
S 20.7005	4340.868	....	+0.002	4340.634	+0.236	+16.3	1
S 21.8100	4349.726	....	+0.007	4349.541	+0.192	13.2	2
S 23.9597	4367.254	....	+0.018	4367.012	+0.260	17.8	1
Ti 24.0282	4367.821	+0.018	....	4367.839			
Ti 26.3119	4387.001	+0.003	....	4387.007			
S 26.4615	4388.281	....	+0.003	4388.100	+0.184	12.6	1
S 29.7918	4417.376	....	±0.000	4417.121	+0.255	17.3	1
Ti 29.8487	Standard	±0.000	....	4417.884			
Ti 35.3198	4468.676	−0.013	....	4468.663			
S 35.6552	4471.917	....	−0.013	4471.676	+0.228	15.3	3
Ti 36.6225	4481.450	−0.012	....	4481.438			
Ti 43.5244	4552.612	+0.020	....	4552.632			
S 43.5584	4552.981	....	+0.020	4552.750	+0.251	16.5	2
Ti 44.5597	Standard	±0.000	....	4563.939			
S 44.9421	4568.167	....	±0.000	4567.950	+0.217	14.2	1

Curvature Cor. +0.0007 mm.

Weighted mean		+ 15.3
V_a	+7.57	
V_d	+0.14	
Reduction to Sun		+ 7.71
Radial Velocity		+23.0 km.

Mean +15.4

ζ PERSEI — B 218

Measured by F.
Power 12

Ti 29.5641	4338.015	+0.069	....	4338.084			
S 29.8943	4340.634	....	+0.075	4340.631	+0.075	+ 5.2	1
Ti 30.3631	4344.370	+0.081	....	4344.451			
S 33.1907	4367.383	....	+0.001	4367.012	+0.372	+25.5	1
Ti 33.2455	Standard	±0.000	....	4367.839			
Ti 35.5309	4387.068	−0.061	....	4387.007			
S 35.6642	4388.208	....	−0.060	4388.100	+0.048	+ 3.3	½
Ti 37.0283	4399.982	−0.047	....	4399.935			
S 38.7463	4415.114	....	−0.055	4415.076	−0.017	− 1.2	½
Ti 39.0629	4417.940	−0.056	....	4417.884			
Ti 44.2508	4466.012	−0.037	....	4465.975			
Ti 44.8131	4471.429	−0.021	....	4471.408			
S 44.8643	4471.925	....	−0.020	4471.676	+0.229	+15.4	2
Ti 45.8403	Standard	±0.000	....	4481.438			
Ti 52.7435	4552.588	+0.044	....	4552.632			
S 52.7644	4552.814	....	+0.043	4552.750	+0.107	+ 7.0	2
Ti 53.0235	4555.626	+0.036	....	4555.662			
Ti 53.7800	4563.897	+0.042	....	4563.939			
S 54.1745	4568.247	....	+0.026	4567.950	+0.323	+21.2	2
Ti 54.5259	4572.143	+0.013	....	4572.156			
S 54.8032	4575.231	....	+0.011	4574.900	+0.343	+22.5	1
Ti 56.1242	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0013 mm.

Weighted Mean		+14.2
V_a	+7.57	
V_d	+0.14	
Reduction to Sun		+ 7.71
Radial Velocity		+21.9 km.

Mean +12.4

ζ *PERSEI*—B 232

1901, November 14, G. M. T. $20^h\ 9^m$
Hour angle W $2^h\ 12^m$

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 20.4179	4387.005	+0.002	....	4387.007			
S 20.5786	4388.380	....	+0.002	4388.100	+0.282	+19.3	1
Ti 21.9154	Standard	±0.000	....	4399.935			
Ti 23.1992	4411.225	+0.015	....	4411.240			
S 23.6635	4415.355	....	+0.014	4415.076	+0.293	19.9	1
S 23.8884	4417.365	....	+0.014	4417.121	+0.258	17.5	1
Ti 29.4079	Standard	±0.000	....	4468.663			
S 29.7458	4471.931	....	±0.000	4471.676	+0.255	17.1	1
Ti 37.6141	4552.633	−0.001	....	4552.632			
S 37.6446	4552.964	....	−0.001	4552.750	+0.213	14.0	1
Ti 38.6481	Standard	±0.000	....	4563.939			
S 39.0408	4568.278	....	−0.022	4567.950	+0.306	20.1	1
Ti 39.3937	4572.199	−0.043	....	4572.156			
S 39.6564	4575.131	....	−0.043	4574.900	+0.188	12.3	1

Curvature Cor. +0.0008 mm.

Weighted mean		+17.2
V_a	+ 4.50	
V_d	− 0.16	
Reduction to Sun		+ 4.34
Radial Velocity		+21.5 km.

Mean +17.2

ζ *PERSEI*—B 232

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave Length	Displacement	Velocity	Weight
Ti 29.6003	Standard	±0.000	....	4338.084			
S 29.9374	4340.753	....	−0.002	4340.634	+0.117	+ 8.1	1
Ti 30.0357	4341.533	−0.003	....	4351.530			
Ti 33.2745	4367.813	+0.026	....	4367.839			
Ti 35.5550	4386.997	+0.010	....	4387.007			
S 35.7042	4388.272	....	+0.010	4388.100	+0.182	12.4	2
Ti 37.5680	4404.420	+0.013	....	4404.433			
S 38.7827	4415.164	....	+0.003	4415.076	+0.091	6.2	1½
Ti 39.0870	Standard	±0.000	....	4417.884			
Ti 44.2955	4465.952	+0.023	....	4465.975			
Ti 44.8288	4471.393	+0.015	....	4471.408			
S 44.8784	4471.874	....	+0.014	4471.676	+0.222	14.8	2
Ti 45.8569	Standard	±0.000	....	4481.438			
Ti 52.7516	Standard	±0.000	....	4552.632			
S 52.7963	4553.117	....	±0.000	4552.750	+0.367	24.2	1
Ti 53.7863	4563.933	+0.006	....	4563.939			
S 54.1777	4568.246	....	−0.006	4567.950	+0.307	20.2	1½
Ti 54.5307	4572.171	−0.015	....	4572.156			
S 54.7863	4575.019	....	−0.013	4574.900	+0.100	6.9	1
Ti 56.1281	4590.151	−0.025	....	4590.126			
Ti 59.4987	Standard	±0.000	....	4629.521			
S 59.6276	4631.067	....	±0.000	4630.703	+0.364	23.6	1
S 60.5525	4642.246	....	±0.000	4641.886	+0.360	23.3	1
Ti 60.8086	4645.369	−0.001	....	4645.368			
Ti 61.7253	4656.651	−0.007	....	4656.644			
S 62.1632	4662.096	....	−0.018	4661.728	+0.350	22.5	1
Ti 62.6184	4667.796	−0.028	....	4667.768			
Ti 65.9195	Standard	±0.000	....	4710.471			
S 66.1666	4713.646	....	+0.002	4713.308	+0.340	21.6	1

Curvature Cor. + 0.0013 mm.

Weighted mean		+16.0
V_a	+ 4.50	
V_d	− 0.16	
Reduction to Sun		+ 4.34
Radial Velocity		+20.3 km.

Mean +16.6

ζ PERSEI—B 424

1902, October 15, G. M. T. $16^h\ 43^m$ — Measured by A.
Hour angle E $3^h\ 25^m$ — Star good; comparison good. — Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 22.2046	Standard	±0.000	....	4338.084			
S 22.5242	4340.628	....	−0.002	4340.634	−0.008	− 0.6	1
S 23.1684	4345.787	....	−0.006	4345.677	+0.104	+ 7.2	2
S 25.7668	4367.033	....	−0.023	4367.012	−0.002	− 0.1	1
Ti 29.0872	4395.246	−0.045	....	4395.201			
Ti 29.6321	4399.994	−0.059	....	4399.935			
S 31.3521	4415.211	....	−0.057	4415.076	+0.078	+ 5.3	2
S 31.5819	4417.271	....	−0.057	4417.121	+0.093	+ 6.3	1
Ti 31.6566	4417.941	−0.057	....	4417.884			
Ti 37.0948	Standard	±0.000	....	4468.663			
S 37.4102	4471.723	....	−0.001	4471.676	+0.046	+ 3.1	1
Ti 38.4027	4481.441	−0.003	....	4481.438			
S 38.4103	4481.516	....	−0.003	4481.400	+0.113	+ 7.6	1
Ti 45.2667	4552.561	+0.071	....	4552.632			
S 45.2827	4552.735	....	+0.071	4552.750	+0.056	+ 3.7	3
Ti 46.2989	4563.886	+0.053	....	4563.939			
S 46.6572	4567.858	....	+0.056	4567.950	−0.036	− 2.4	2
Ti 47.0375	4572.097	+0.059	....	4572.156			
S 47.2942	4574.972	....	+0.055	4574.900	+0.127	+ 8.3	1
Ti 50.9749	Standard	±0.000	....	4617.452			

Curvature Cor. +0.0009 mm.

Weighted mean		+ 3.8	Mean + 3.8
V_a	+18.40		
V_d	+ 0.23		
Reduction to Sun		+18.63	
Radial Velocity		+22.4 km.	

SUMMARY OF MEASURES OF *ζ PERSEI.*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 226	1901, Sept. 12	+22.5	7	......	..
A 235	Sept. 18	+23.2	5	......	..
B 218	Nov. 8	+23.0	8	+21.9	8
B 232	Nov. 14	+21.5	7	+20.3	11
B 424	1902, Oct. 15	+22.4	10	......	..
Mean		+22.5		+21.1	

Mean of 5 plates +22.3 km.
Mean of all measures +22.1 km.

6. *β ORIONIS.*

(R. A. = $5^h\ 10^m$; Dec. = −8° 19′; Mag. 0.3; Class VIc)

Especial attention has been given to the investigation of this well-known star because of the Potsdam observations of 1890, which seemed to indicate a variation in its radial velocity. A total of nineteen plates extending over an interval of six months have been measured, five by F., and nineteen by A. The results do not indicate any variation of velocity. The spectrum of this star is characterized by the strength of its *Orion* lines and the existence of several faint metallic lines. The breadth of these lines is the chief difficulty in the way of accurate measurement.

1901, September 4, G. M. T. $21^h\ 43^m$
Hour angle E $2^h\ 29^m$

β ORIONIS—A 207

Star strong; comparison good.

Measured by A. with Zeiss Comparator
Power 18

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 62.4073	Standard	±0.000	....	4338.084			
S 62.1758	4340.544	....	±0.000	4340.634	−0.090	−6.2	1
S 57.8843	4387.998	....	−0.005	4388.100	−0.107	7.3	1
Ti 57.2599	4395.207	−0.006	....	4395.201			
Ti 56.8542	Standard	±0.000	....	4399.935			
Ti 52.1340	4457.600	±0.000	....	4457.600			
Ti 51.2739	4468.665	−0.002	....	4468.663			
S 51.0433	4471.662	....	−0.002	4471.676	−0.016	1.1	1
S 50.3072	4481.319	....	±0.000	4481.400	−0.081	5.4	1
Ti 50.2982	Standard	±0.000	....	4481.438			

Curvature Cor. −0.0002 mm. Weighted mean − 5.0 Mean −5.0

V_a +25.24
V_d + 0.20

Reduction to Sun +25.44
Radial Velocity +20.4 km.

1901, October 3, G. M. T. $19^h\ 26^m$
Hour angle E $2^h\ 49^m$

β ORIONIS—A 262

Star good; comparison good.

Measured by A.
Power 21

Ti 19.2059	Standard	±0.000	....	4338.084			
S 23.7369	4388.179	....	−0.046	4388.100	+0.033	+2.2	1
Ti 24.7553	4399.992	−0.057	....	4399.935			
S 27.8874	4437.700	....	−0.005	4437.718	−0.023	−1.6	1
Ti 28.3915	4443.972	+0.004	....	4443.976			
Ti 28.8172	Standard	±0.000	....	4449.313			
Ti 30.3324	4468.668	−0.005	....	4468.663			
S 30.5638	4471.672	....	−0.001	4471.676	−0.005	−0.3	1
S 31.3043	4481.374	....	+0.014	4481.400	−0.012	−0.8	1
Ti 31.3081	4481.424	+0.014	....	4481.438			
Ti 37.2144	Standard	±0.000	....	4563.939			
S 37.4833	4567.928	....	±0.000	4567.950	−0.022	−1.4	1

Curvature Cor. +0.0001 mm. Weighted mean − 0.4 Mean −0.4

V_a +22.92
V_d + 0.23

Reduction to Sun +23.15
Radial Velocity +22.8 km.

1901, October 18, G. M. T. $20^h\ 7^m$
Hour angle E $1^h\ 12^m$

β ORIONIS—B 207

Star good; comparison good.

Measured by A.
Power 24

Ti 22.9731	Standard	±0.000	....	4338.084			
S 23.3055	4340.709	....	−0.001	4340.634	+0.074	+5.1	2
S 29.0872	4388.203	....	−0.019	4388.100	+0.084	5.7	1
Ti 29.9062	4395.223	−0.022	....	4395.201			
S 34.6936	4437.824	....	−0.003	4437.718	+0.103	7.0	1
Ti 35.3601	Standard	±0.000	....	4443.976			
Ti 37.9741	4468.654	+0.009	....	4468.663			
S 38.2864	4471.663	....	+0.017	4471.676	+0.004	0.3	3
S 39.2846	4481.367	....	+0.045	4481.400	+0.012	0.8	4
Ti 39.2873	4481.393	+0.045	....	4481.438			
Ti 45.8676	Standard	±0.000	....	4548.938			
Ti 46.2087	4552.618	+0.014	....	4552.632			
S 46.2208	4552.749	....	+0.014	4552.750	+0.013	0.9	1

Curvature Cor. +0.0002 mm. Weighted mean + 2.3 Mean +3.3

V_a +19.38
V_d + 0.10

Reduction to Sun +19.48
Radial Velocity +21.8 km.

β *ORIONIS*—B 207

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 19.675	Standard	±0.000	....	4338.084			
S 19.994	4340.604	....	−0.003	4340.634	−0.033	−2.3	1
Ti 25.656	4387.079	−0.072	....	4387.007			
S 25.777	4388.105	....	−0.070	4388.100	−0.065	−4.4	1
Ti 30.239	4427.276	−0.010	....	4427.266			
Ti 34.680	Standard	±0.000	....	4468.663			
S 34.996	4471.705	....	+0.008	4471.676	+0.037	+2.5	2
S 35.984	4481.303	....	+0.035	4481.400	−0.062	−4.2	3
Ti 35.994	4481.403	+0.035	....	4481.438			
Ti 43.959	4563.906	+0.033	....	4563.939			
S 44.327	4567.954	....	+0.029	4567.950	+0.033	+2.2	2
Ti 46.308	Standard	±0.000	....	4590.126			

Weighted mean —1.1 Mean —1.2
Curvature Cor. —0.17
V_a +19.38
V_d + 0.10
Reduction to Sun +19.48
Radial Velocity +18.2 km.

β *ORIONIS*—A 284

1901, October 31, G. M. T. 19h 58m
Hour angle E 0h 29m

Star good; comparison good.

Measured by A.
Power 21

S 23.5148	4340.641	....	±0.000	4340.634	+0.007	+0.5	2
Ti 23.5983	Standard	±0.000	....	4341.530			
Ti 27.7147	4387.009	−0.002	....	4387.007			
S 27.8156	4388.166	....	−0.002	4388.100	+0.064	4.7	3
Ti 29.2155	Standard	±0.000	....	4401.433			
Ti 34.2076	4465.956	+0.019	....	4465.975			
S 34.6563	4471.772	....	+0.012	4476.676	+0.108	7.2	3
S 35.3907	4481.400	....	±0.000	4481.400	±0.000	0.0	3
Ti 35.3936	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm. Weighted mean + 3.2 Mean +3.0
V_a +15.23
V_d + 0.04
Reduction to Sun +15.27
Radial Velocity +18.5 km.

β *ORIONIS*—B 213

1901, November 7, G. M. T., 18h 6m
Hour angle E 1h 50m

Star good; comparison fair.

Measured by A.
Power 21

S 33.3753	4388.314	....	±0.000	4388.100	+0.214	+14.6	1
Ti 34.7200	Standard	±0.000	....	4399.935			
Ti 42.2191	4468.689	−0.026	....	4468.663			
S 42.5474	4471.862	....	−0.020	4471.676	+0.166	11.1	1
Ti 43.5294	Standard	±0.000	....	4481.438			
S 43.5355	4481.498	....	±0.000	4481.400	+0.098	6.6	2
Ti 53.8091	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm. Weighted mean + 9.7 Mean +10.8
V_a +12.67
V_d + 0.16
Reduction to Sun +12.83
Radial Velocity +22.5 km.

β *ORIONIS* — B 220

1901, November 8, G. M. T. 20^h 6^m
Hour angle W 0^h 10^m

Star good; comparison slightly weak.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m	t. m.	km.	
Ti 20.1587	Standard	±0.000	....	4338.084			
S 20.4953	4340.749	....	−0.001	4340.634	+0.114	+7.9	2
S 21.9256	4352.202	....	−0.005	4352.083	+0.114	7.9	2
S 26.2738	4388.332	....	−0.018	4388.100	+0.214	14.6	1
Ti 27.0757	4395.221	−0.020	....	4395.201			
Ti 32.5195	Standard	±0.000	....	4443.976			
Ti 35.1300	4468.661	+0.002	....	4468.663			
S 35.4584	4471.830	....	+0.004	4471.676	+0.158	10.6	2
Ti 36.4438	4481.427	+0.011	....	4481.438			
S 36.4585	4481.587	....	+0.011	4481.400	+0.198	13.2	3
Ti 45.1340	Standard	±0.000	....	4572.156			
S 46.2063	4584.173	....	±0.000	4584.018	+0.155	10.1	1

Curvature Cor. +0.0009 mm.

Weighted mean +10.7 Mean +10.7
V_a +12.25
V_d − 0.01
Reduction to Sun +12.24
Radial Velocity +22.9 km.

β *ORIONIS* — B 231

1901, November 14, G. M. T. 19^h 19^m
Hour angle E 0^h 15^m

Star good; comparison good.

Measured by A.
Power 21

Ti 18.6998	Standard	±0.000	....	4338.084			
S 19.0460	4340.831	....	−0.003	4340.634	+0.194	+13.4	1
Ti 24.6539	4387.055	−0.048	....	4387.007			
S 24.7978	4388.286	....	−0.047	4388.100	+0.139	9.5	1
Ti 33.6420	4468.662	+0.001	....	4468.663			
S 33.9775	4471.906	....	+0.001	4471.676	+0.231	15.5	1
Ti 34.9543	Standard	±0.000	....	4481.438			
S 34.9709	4481.601	....	±0.000	4481.400	+0.201	13.4	3
S 44.7033	4584.259	....	±0.000	4584.018	+0.241	15.8	1
Ti 45.2195	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm.

Weighted mean +13.5 Mean +13.5
V_a + 9.85
V_d + 0.02
Reduction to Sun + 9.87
Radial Velocity +23.4 km.

β *ORIONIS* — B 237

1901, November 15, G. M. T. 18^h 52^m
Hour angle E 0^h 35^m

Star good; comparison good.

Measured by A.
Power 21

Ti 20.7414	Standard	±0.000	....	4338.084			
S 21.0810	4340.777	....	−0.002	4340.634	+0.141	+9.7	1
Ti 26.6980	4387.049	−0.042	......	4387.007			
S 26.8506	4388.354	....	−0.041	4388.100	+0.213	14.5	2
Ti 34.3108	Standard	±0.000	....	4455.485			
Ti 35.6896	4468.656	+0.007	......	4468.663			
S 36.0229	4471.878	....	+0.012	4471.676	+0.214	14.4	3
Ti 37.0002	4481.412	+0.026	....	4481.438			
S 37.0130	4481.538	....	+0.026	4481.400	+0.164	11.0	4
S 46.7429	4584.143	....	+0.001	4584.018	+0.126	8.2	1
Ti 47.2694	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm.

Weighted mean +12.2 Mean +11.6
V_a +9.44
V_d +0.05
Reduction to Sun + 9.49
Radial Velocity +21.7 km.

β ORIONIS — B 252

1901, November 27, G. M. T. $21^h 22^m$ — Measured by A.
Hour angle W $2^h 43^m$ — Star good; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 18.1164	Standard	±0.000	....	4338.084			
S 18.4616	4340.849	....	−0.001	4340.634	+0.211	+14.6	1
Ti 24.0166	4387.076	−0.069	....	4387.007			
S 24.1593	4388.308	....	−0.068	4388.100	+0.140	9.6	1
Ti 32.9216	Standard	±0.000	....	4468.663			
S 33.2595	4471.959	....	+0.003	4471.676	+0.286	19.2	2
Ti 34.2210	4481.424	+0.014	....	4481.438			
S 34.2413	4481.625	....	+0.014	4481.400	+0.239	16.0	3
Ti 41.4023	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0009 mm. — Weighted mean +15.8 — Mean +14.8

V_a +4.23
V_d −0.22

Reduction to Sun + 4.01
Radial Velocity +19.8 km.

β ORIONIS — B 257

1901, December 18, G. M. T. $18^h 12^m$ — Measured by A.
Hour angle W $0^h 56^m$ — Star good; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 17.0931	Standard	±0.000	....	4338.084			
S 17.4562	4341.007	....	−0.002	4340.634	+0.371	+25.6	1
Ti 22.9621	4387.039	−0.032	....	4387.007			
S 23.1360	4388.547	....	−0.032	4388.100	+0.415	28.4	2
Ti 31.4164	Standard	±0.000	....	4464.617			
S 32.1790	4472.068	....	+0.032	4471.676	+0.424	28.4	3
Ti 33.1190	4481.363	+0.075	....	4481.438			
S 33.1516	4481.687	....	+0.075	4481.400	+0.362	24.2	2
S 42.7593	4584.341	....	±0.000	4584.018	+0.323	21.1	1
Ti 43.2620	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0007 mm. — Weighted mean +26.3 — Mean +25.6

V_a −5.14
V_d −0.08

Reduction to Sun − 5.22
Radial Velocity +21.1 km.

β ORIONIS — A 297

1901, December 19, G. M. T. $17^h 34^m$ — Measured by A.
Hour angle W $0^h 23^m$ — Star good; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 21.0390	Standard	±0.000	....	4338.084			
S 21.3084	4341.000	....	−0.002	4340.634	+0.364	+25.2	1
Ti 25.4010	4387.040	−0.033	....	4387.007			
S 25.5270	4388.511	....	−0.029	4388.100	+0.382	26.1	2
Ti 26.4958	Standard	±0.000	....	4399.935			
Ti 31.9849	4468.652	+0.011	....	4468.663			
S 32.2453	4472.091	....	+0.008	4471.676	+0.423	28.4	2
Ti 32.9465	Standard	±0.000	....	4481.438			
S 32.9680	4481.726	....	±0.000	4481.400	+0.326	21.8	2

Curvature Cor. +0.0006 mm. — Weighted mean +25.4 — Mean +25.4

V_a −5.58
V_d −0.03

Reduction to Sun − 5.61
Radial Velocity +19.8 km.

β *ORIONIS* — B 261

1901, December 31, G. M. T. $15^h\ 12^m$ | Star good ; comparison good. | Measured by A.
Hour angle E $1^h\ 12^m$ | Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 23.8840	4341.118	....	±0.000	4340.634	+0.484	+33.4	2
Ti 23.9354	Standard	±0.000	....	4341.530			
Ti 29.4018	4387.014	−0.007	....	4387.007			
S 29.5832	4388.581	....	−0.006	4388.100	+0.475	32.5	1
Ti 31.3940	Standard	±0.000	....	4404.433			
Ti 37.8867	4464.638	−0.021	....	4464.617			
S 38.6513	4472.097	....	−0.012	4471.676	+0.409	27.4	3
Ti 39.5972	Standard	±0.000	....	4481.438			
S 39.6438	4481.901	....	±0.000	4481.400	+0.501	33.5	4

Curvature Cor. +0.0008 mm. | Weighted mean +31.6 | Mean +31.7

V_a −10.69
V_d + 0.10

Reduction to Sun −10.59
Radial Velocity +21.0 km.

β *ORIONIS* — B 261

Measured by F.
Power 12

S 29.9627	4341.268	....	+0.001	4340.634	+0.635	+43.9	1
Ti 30.3581	Standard	±0.000	....	4344.451			
Ti 35.4653	4387.066	−0.059	....	4387.007			
S 35.6385	4388.562	....	−0.059	4388.100	+0.403	27.5	1
Ti 39.9853	Standard	±0.000	....	4427.266			
Ti 44.0880	4465.969	+0.006	....	4465.975			
S 44.7186	4472.117	....	+0.003	4471.676	+0.444	29.8	3
Ti 45.6641	Standard	±0.000	....	4481.438			
S 45.7128	4481.921	....	±0.000	4481.400	+0.521	34.9	3

Weighted mean +33.2 | Mean +34.0
Curvature Cor. − 0.82

V_a −10.69
V_d + 0.10

Reduction to Sun −10.59
Radial Velocity +21.8 km.

β *ORIONIS* — A 300

1902, January 4, G. M. T. $17^h\ 44^m$ | Star strong ; comparison good. | Measured by A.
Hour angle W $1^h\ 35^m$ | Power 21

Ti 22.4561	Standard	±0.000	....	4338.084			
S 22.7409	4341.162	....	−0.003	4340.634	+0.525	+36.3	1
Ti 26.8268	4387.053	−0.046	....	4387.007			
S 26.9671	4388.688	....	−0.043	4388.100	+0.545	37.2	2
Ti 28.8668	Standard	±0.000	....	4411.240			
Ti 33.4260	4468.678	−0.015	....	4468.663			
S 33.6985	4472.269	....	−0.011	4471.676	+0.582	39.0	2
Ti 34.3880	Standard	±0.000	....	4481.438			
S 34.4196	4481.861	....	±0.000	4481.400	+0.461	30.8	3

Curvature Cor. +0.0005 mm. | Weighted mean +35.2 | Mean +35.8

V_a −12.35
V_d − 0.14

Reduction to Sun −12.49
Radial Velocity +22.7 km.

1902, January 8, G. M. T. 18h 15m
Hour angle W 2h 24m

β ORIONIS—A 306

Star good; comparison good.

Measured by A.
Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 26.0198	Standard	±0.000	....	4338.084			
S 26.3109	4311.220	....	±0.000	4340.634	+0.586	+40.5	1
S 30.5367	4388.582	....	±0.000	4388.100	+0.482	32.9	1
Ti 31.5042	Standard	±0.000	....	4399.935			
Ti 37.0198	4468.652	+0.011	....	4468.663			
S 37.2933	4472.248	....	+0.008	4471.676	+0.580	38.9	2
Ti 37.9859	Standard	±0.000	....	4481.438			
S 38.0223	4481.924	....	±0.000	4481.400	+0.524	35.1	1

Curvature Cor. +0.0005 mm.

Weighted mean		+37.2	Mean +36.8
V_a	−13.92		
V_d	− 0.20		
Reduction to Sun		−14.12	
Radial Velocity		+23.1 km.	

1902, January 9, G. M. T. 14h 41m
Hour angle E 1h 14m

β ORIONIS—B 270

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 18.3004	Standard	±0.000	....	4338.084			
S 24.3850	4388.587	....	±0.000	4388.100	+0.487	+33.3	1
Ti 25.6876	Standard	±0.000	....	4399.935			
Ti 33.1168	4468.654	+0.009	....	4468.663			
S 33.4863	4472.261	....	+0.007	4471.676	+0.592	39.7	1
Ti 34.4178	Standard	±0.000	....	4481.438			
S 34.4691	4481.947	....	±0.000	4481.400	+0.547	36.5	2
Ti 44.6069	Standard	±0.000	....	4590.126			
Ti 50.1609	Standard	±0.000	....	4656.644			
Ti 54.3252	Standard	±0.000	....	4710.368			
S 54.5924	4713.937	....	±0.000	4713.308	+0.629	40.0	1

Curvature Cor. +0.0008 mm.

Weighted mean		+37.2	Mean +37.4
V_a	−14.24		
V_d	+ 0.11		
Reduction to Sun		−14.13	
Radial Velocity		+23.1 km.	

β ORIONIS—B 270

Measured by F.
Power 13

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 29.9906	4311.124	....	−0.001	4340.634	+0.489	+33.8	2
Ti 30.0412	Standard	±0.000	....	4341.530			
Ti 35.5109	4387.073	−0.067	....	4387.007			
S 35.7116	4388.806	....	−0.069	4388.100	+0.637	43.5	2
Ti 44.1458	4465.986	−0.011	....	4465.975			
Ti 44.7062	4471.435	−0.027	....	4471.408			
S 44.7878	4472.231	....	−0.013	4471.676	+0.542	36.3	3
Ti 45.7239	Standard	±0.000	....	4481.438			
S 45.7722	4481.917	....	±0.000	4481.400	+0.517	34.6	3
Ti 63.4749	Standard	±0.000	....	4682.088			
Ti 65.6312	4710.406	−0.038	....	4710.368			
S 65.8922	4713.901	....	−0.038	4713.308	+0.555	35.3	1

Weighted mean		+36.5	Mean +36.7
Curvature Cor.		− 0.82	
V_a	−14.24		
V_d	+ 0.11		
Reduction to Sun		−14.13	
Radial Velocity		+21.6 km.	

1902, January 16, G. M. T. 17ʰ 3ᵐ — *β ORIONIS*—B 277 — Measured by A.
Hour angle W 1ʰ 46ᵐ — Star good; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 17.2623	Standard	±0.000	....	4338.084			
S 17.6427	4341.132	....	−0.002	4340.634	+0.496	+34.3	1
Ti 23.1558	4387.042	−0.035	....	4387.007			
Ti 24.6347	Standard	±0.000	....	4399.935			
S 28.8554	4438.179	....	+0.046	4437.718	+0.507	34.3	1
Ti 29.4687	4443.923	+0.053	....	4443.976			
Ti 32.0516	4468.657	+0.006	....	4468.663			
S 32.4205	4472.263	....	+0.004	4471.676	+0.591	39.6	3
Ti 33.3503	Standard	±0.000	....	4481.438			
S 33.3924	4481.856	....	±0.000	4481.400	+0.456	30.5	2
S 43.0322	4584.478	....	±0.000	4584.018	+0.460	30.1	1
Ti 43.5254	Standard	±0.000	....	4590.126			
Ti 49.0727	Standard	±0.000	....	4656.644			
Ti 53.2285	Standard	±0.000	....	4710.368			
S 53.4933	4713.913	....	±0.000	4713.308	+0.605	38.5	2

Curvature Cor. +0.0008 mm. — Weighted mean +35.6 — Mean +34.5

V_a −16.81
V_d − 0.15

Reduction to Sun −16.96
Radial Velocity +18.6 km.

β ORIONIS—B 277 — Measured by F. with Zeiss Comparator
Power 17

S 24.4155	4341.181	....	±0.000	4340.634	+0.547	+37.8	2
Ti 24.4587	Standard	±0.000	....	4341.530			
Ti 29.8992	4387.055	−0.048	....	4387.007			
S 30.0715	4388.550	....	−0.048	4388.100	+0.402	27.5	3
Ti 38.4880	Standard	±0.000	....	4465.975			
Ti 39.0440	4471.412	−0.004	....	4471.408			
S 39.1255	4472.213	....	−0.004	4471.676	+0.533	35.7	2
Ti 40.0540	4481.398	+0.040	....	4481.438			
S 40.0952	4481.808	....	+0.040	4481.400	+0.448	30.0	4
Ti 44.1042	4522.918	+0.058	....	4522.974			
S 44.1345	4523.237	....	+0.058	4522.802	+0.493	32.7	1
S 49.7010	4584.492	....	+0.005	4584.018	+0.479	31.3	½
Ti 50.1905	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0011 mm. — Weighted mean +31.82 — Mean +32.5

V_a −16.81
V_d − 0.15

Reduction to Sun −16.96
Radial Velocity +14.9 km.

1902, January 24, G. M. T. 12ʰ 50ᵐ — *β ORIONIS*—B 282 — Measured by F. with Zeiss Comparator
Hour angle E 2ʰ 00ᵐ — Star good; comparison good. — Power 13

Ti 32.207	Standard	±0.000	....	4338.084			
S 32.586	4341.132	....	±0.001	4340.634	+0.497	+34.3	1
Ti 38.076	4387.024	−0.017	....	4387.007			
S 38.257	4388.594	....	−0.017	4388.100	+0.477	32.6	1
Ti 39.551	Standard	±0.000	....	4399.935			
Ti 46.937	4468.665	−0.002	....	4468.663			
S 47.309	4472.318	....	−0.002	4471.676	+0.640	42.9	1
Ti 48.229	Standard	±0.000	....	4481.438			
S 48.288	4482.026	....	±0.000	4481.400	+0.626	41.9	2

Curvature Cor. +0.0011 mm. — Weighted mean +38.7 — Mean +37.9

V_a −19.32
V_d + 0.17

Reduction to Sun −19.15
Radial Velocity +19.6 km.

β ORIONIS—B 282

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 23.2788	Standard	±0.000	....	4338.084			
S 23.6556	4341.106	....	±0.000	4340.634	+0.472	+32.6	2
S 29.3646	4388.745	....	±0.000	4388.100	+0.645	44.1	2
Ti 30.1065	Standard	±0.000	....	4395.201			
Ti 31.9213	4411.266	−0.026	....	4411.240			
S 32.6320	4417.665	....	−0.023	4417.121	+0.521	35.4	1
Ti 38.0620	Standard	±0.000	....	4468.663			
S 38.4323	4472.283	....	±0.000	4471.676	+0.607	40.7	3
Ti 39.3653	4481.488	−0.050	....	4481.438			
S 39.4324	4482.028	....	−0.050	4481.400	+0.578	38.7	1
Ti 55.0843	Standard	±0.000	....	4656.644			
Ti 57.0867	Standard	±0.000	....	4682.088			
Ti 58.3815	Standard	±0.000	....	4698.946			
S 59.5088	4713.891	....	±0.000	4713.308	+0.583	37.1	3

Curvature Cor. +0.0008 mm. Weighted mean +38.4 Mean +38.1

	V_a −19.32	
	V_d + 0.17	
Reduction to Sun		−19.15
Radial Velocity		+19.2 km.

β ORIONIS—A 312

1902, February 10, G. M. T. $14^h\ 54^m$
Hour angle, W $1^h\ 10^m$

Star good; comparison good.

Measured by A.
Power 21

Ti 25.3630	Standard	±0.000	....	4338.084			
S 25.6543	4341.234	....	−0.001	4340.634	+0.599	+41.4	2
Ti 29.7287	4387.019	−0.012	....	4387.007			
S 29.8806	4388.791	....	−0.011	4388.100	+0.680	46.4	1
Ti 31.7702	Standard	±0.000	....	4411.240			
S 33.9747	4438.429	....	+0.007	4437.718	+0.718	48.5	1
Ti 34.4129	4443.967	+0.009	....	4443.976			
Ti 36.3238	4468.657	+0.006	....	4468.663			
S 36.6081	4472.407	....	+0.001	4471.676	+0.735	49.3	3
Ti 37.2864	Standard	±0.000	....	4481.438			
S 37.3279	4481.994	....	±0.000	4481.400	+0.594	39.7	3

Curvature Cor.+0.0005 mm. Weighted mean +44.5 Mean+45.1

	V_a −23.47	
	V_d − 0.10	
Reduction to Sun		−23.57
Radial Velocity		+20.9 km.

β ORIONIS—A330

1902, March 3, G. M. T. $13^h\ 44^m$
Hour angle W $1^h\ 23^m$

Star good; comparison good.

Measured by A.
Power 21

Ti 22.3238	Standard	±0.000	....	4338.084			
S 22.6222	4341.307	....	±0.000	4340.634	+0.673	+46.5	2
Ti 26.6919	4386.978	+0.029	....	4387.007			
S 26.8362	4388.658	....	+0.027	4388.100	+0.585	40.0	2
Ti 27.7949	Standard	±0.000	....	4399.935			
Ti 33.2998	4468.672	−0.009	....	4468.663			
S 33.5810	4472.377	....	−0.006	4471.676	+0.695	46.6	4
Ti 31.2624	Standard	±0.000	....	4481.438			
S 34.3070	4482.035	....	±0.000	4481.400	+0.635	42.5	3

Curvature Cor.+0.0005 mm. Weighted mean +44.3 Mean +43.9

	V_a −25.63	
	V_d − 0.12	
Reduction to Sun		−25.75
Radial Velocity		+18.5 km.

SUMMARY OF MEASURES OF β *ORIONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A207	1901, Sept. 4	+20.4	4	......	..
A262	Oct. 3	+22.8	5	......	..
B207	Oct. 18	+21.8	6	+18.2	5
A284	Oct. 31	+18.5	4	......	..
B213	Nov. 7	+22.5	3	......	..
B220	Nov. 8	+22.9	6	......	..
B231	Nov. 14	+23.4	5	......	..
B237	Nov. 15	+21.7	5	......	..
B252	Nov. 27	+19.8	4	......	..
B257	Dec. 18	+21.1	5	......	..
A297	Dec. 19	+19.8	4	......	..
B261	Dec. 31	+21.0	4	+21.8	4
A300	1902, Jan. 4	+22.7	4	......	..
A306	Jan. 8	+23.1	4	......	.
B270	Jan. 9	+23.1	4	+21.6	5
B277	Jan. 16	+18.6	6	+14.9	5
B282	Jan. 24	+19.2	6	+19.6	4
A312	Feb. 10	+20.9	5	......	..
A330	Mar. 3	+18.5	4	......	..

Mean +21.1 +19.2
Mean of 19 plates +20.9 km.
Mean of all measures +20.7 km.

7. γ *ORIONIS*

(R. A.=5^h 20^m; Dec.=+6° 15′; Mag. 1.9; Class IV*a*)

Seven plates of this star have been measured, six by A., and four by F., with three common to the two observers. An interesting systematic difference seems to exist in the two sets of measures, which is probably due to the different personality effects which enter into the settings upon the broad lines of the star spectrum. The general features of this spectrum are very similar to those of ζ *Persei.*

γ *ORIONIS*—A224

1901, September 11, G. M. T. 21^h 32^m — Measured by A.
Hour angle E 2^h 17^m — Star fair; comparison rather weak. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 26.0285	4340.459	....	±0.000	4340.634	−0.175	−12.1	4
H 26.0449	Standard	±0.000	....	4340.634			
S 30.3242	4387.938	....	−0.056	4388.100	−0.218	14.9	2
Ti 30.9596	4395.266	−0.065	....	4395.201			
Ti 36.9536	Standard	±0.000	....	4468.663			
S 37.1664	4471.419	....	+0.028	4471.676	−0.229	15.4	2
He 37.1849	4471.648	+0.028	....	4471.676			
S 37.9127	4481.174	....	+0.027	4481.400	−0.199	13.3	4
Ti 42.8823	4549.788	+0.020	....	4549.808			
S 43.0712	4552.529	....	+0.018	4552.750	−0.203	13.4	1
Ti 43.8492	4563.926	+0.013	....	4563.939			
S 44.1047	4567.708	....	+0.007	4567.950	−0.235	15.4	1
Ti 44.4036	Standard	±0.000	....	4572.156			2
S 44.5777	4574.759	....	±0.000	4574.900	−0.141	9.2	

Curvature Cor. +0.0001 mm. Weighted mean −13.1 Mean −13.4

V_a +28.31
V_d + 0.19

Reduction to Sun +28.50
Radial Velocity +15.4 km.

γ ORIONIS—A 258

1901, October 2, G. M. T. $21^h 34^m$ Measured by A.
Hour angle E $0^h 47^m$ Star good; comparison good. Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m	t. m.	km.	
Ti 18.1261	Standard	±0.000	......	4338.084			
S 18.3507	4340.474	....	−0.004	4340.634	−0.161	−11.1	1
Ti 22.5613	4387.039	−0.032	....	4387.007			
S 22.6451	4388.001	....	−0.032	4388.100	−0.131	9.0	2
Ti 23.6768	4399.961	−0.026	....	4399.935			
S 24.9370	4414.871	....	−0.016	4415.076	−0.221	15.0	1
Ti 25.9640	4427.274	−0.008	....	4427.266			
S 26.7986	4437.526	....	−0.004	4437.718	−0.196	13.2	1
Ti 27.7427	Standard	±0.000	....	4449.313			
Ti 29.2569	4468.653	+0.010	....	4468.663			
S 29.4801	4471.551	....	+0.013	4471.676	−0.112	7.5	2
S 30.2139	4481.163	....	+0.026	4481.400	−0.211	14.1	1
Ti 30.2328	4481.412	+0.026	....	4481.438			
Ti 36.1383	Standard	±0.000	....	4563.939			
S 36.3967	4567.774	....	±0.000	4567.950	−0.176	11.6	1

Curvature Cor. + 0.0001 mm. Weighted mean −10.9 Mean −11.6

V_a + 26.61
V_d + 0.07

Reduction to Sun + 26.68
Radial Velocity + 15.8 km.

γ ORIONIS—B 221

1901, November 8, G. M. T. $20^h 38^m$ Measured by A.
Hour angle W $0^h 32^m$ Star fair; comparison good. Power 14

Ti 20.0778	Standard	±0.000	....	4338.084			
S 20.4093	4340.706	....	−0.001	4340.634	+0.071	+4.9	1
Ti 26.0447	4387.035	−0.028	....	4387.007			
S 26.1716	4388.118	....	−0.026	4388.100	−0.008	−0.6	2
Ti 27.5425	Standard	±0.000	....	4399.935			
Ti 35.0484	4468.668	−0.005	....	4468.663			
S 35.3560	4471.642	....	−0.004	4471.676	−0.038	−2.5	1
Ti 36.3606	Standard	±0.000	....	4481.438			
S 36.3629	4481.461	....	±0.000	4481.400	+0.061	+4.1	1
S 43.2799	4552.791	....	±0.000	4552.750	+0.041	+2.7	1
Ti 43.5444	Standard	±0.000	....	4555.662			
Ti 44.3037	4563.962	−0.023	....	4563.939			
S 44.6755	4568.060	....	−0.018	4567.950	+0.092	+6.0	3
Ti 46.6437	4590.128	−0.002	....	4590.126			
Ti 49.0040	Standard	±0.000	....	4617.452			
Ti 52.2489	4656.637	+0.007	....	4656.644			
Ti 54.2731	Standard	±0.000	....	4682.088			
Ti 56.4512	4710.389	−0.024	....	4710.368			
S 56.6702	4713.289	....	−0.021	4713.308	−0.040	−2.5	3

Curvature Cor. +0.0009 mm. Weighted mean + 1.6 Mean +1.7

V_a +15.47
V_d − 0.05

Reduction to Sun +15.42
Radial Velocity +17.0 km.

γ *ORIONIS*—B 221

Measured by F.
Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 30.0031	Standard	±0.000	....	4387.007			
S 30.1385	4388.164	....	−0.001	4388.100	+0.063	+ 4.3	3
S 33.2198	4415.067	....	−0.035	4415.076	−0.044	− 3.0	1
Ti 33.2198	4417.922	−0.038	....	4417.884			
Ti 38.7276	4465.997	−0.022	....	4465.975			
S 39.3271	4471.773	....	−0.014	4471.676	+0.083	+ 5.6	3
Ti 40.3191	Standard	±0.000	....	4481.438			
S 40.3295	4481.540	....	±0.000	4481.400	+0.140	+ 9.4	½
Ti 47.2247	4552.601	+0.031	....	4552.632			
S 47.2543	4552.924	....	+0.031	4552.750	+0.202	+13.3	1½
Ti 47.5037	4555.627	+0.035	....	4555.662			
S 48.6214	4567.875	....	+0.016	4567.950	−0.059	− 3.9	1
Ti 50.6058	Standard	±0.000	....	4590.126			

Curvature Cor. + 0.0013 mm. Weighted mean + 4.8 Mean + 4.3

V_a +15.47
V_d − 0.05

Reduction to Sun +15.42
Radial Velocity +20.2 km.

γ *ORIONIS*—B 253

1901, November 27, G. M. T. 21ʰ 55ᵐ
Hour angle W 3ʰ 8ᵐ

Star strong; not quite centrally between comparison spectra.

Measured by F.
Power 14

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 29.9085	4340.732	....	+0.067	4340.634	+0.165	+11.4	2
Ti 29.9995	4341.463	+0.067	....	4341.530			
Ti 35.4665	Standard	±0.000	....	4387.007			
S 35.6305	4388.424	....	±0.000	4388.100	+0.324	22.1	2
Ti 39.9935	4427.264	+0.002	....	4427.266			
S 41.1325	4437.783	....	−0.001	4437.718	+0.064	4.3	½
Ti 42.3615	4449.318	−0.005	....	4449.313			
Ti 44.1005	Standard	±0.000	....	4465.975			
S 44.7040	4471.850	....	+0.004	4471.676	+0.178	11.9	3
Ti 45.6765	4481.423	+0.013	....	4481.438			
S 45.7025	4481.680	....	+0.013	4481.400	+0.293	19.6	½
Ti 52.5135	4552.592	+0.040	....	4552.632			
S 52.5510	4553.002	....	+0.035	4552.750	+0.287	18.9	1
Ti 52.7915	4555.638	+0.024	....	4555.662			
S 53.9210	4568.144	....	+0.020	4567.950	+0.214	14.0	2
Ti 55.8615	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0015 mm. Weighted mean +14.7 Mean +14.6

V_a +6.75
V_d −0.25

Reduction to Sun + 6.50
Radial Velocity +21.2 km.

γ *ORIONIS*—B 262

1902, December 31, G. M. T. $15^h\ 38^m$
Hour angle E $0^h\ 58^m$

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 30.1486	4471.434	−0.026	....	4471.408			
S 30 2116	4472.051	....	−0.026	4471.676	+0.349	+23.4	2
Ti 31.1632	Standard	±0.000	....	4481.438			
Ti 37.9928	4552.617	+0.015	....	4552.632			
S 38.0449	4553.187	....	+0.015	4552.750	+0.452	29.8	1
Ti 41.3381	Standard	±0.000	....	4590.126			
S 41.4567	4591.490	....	±0.000	4591.066	+0.424	27.7	1
S 44.0480	4621.909	....	+0.023	4621.549	+0.383	24.8	1
Ti 44.1603	4623.255	+0.023	....	4623.279			
S 46.3328	4649.742	....	+0.012	4649.250	+0.504	32.5	2
Ti 46.8864	4656.635	+0.009	....	4656.644			
Ti 50.1830	4698.940	+0.006	....	4698.946			
S 50.2450	4699.757	....	+0.006	4699.340	+0.423	27.0	2
Ti 51.0447	Standard	±0.000	....	4710.368			
S 51.2930	4713.690	....	±0.000	4713.308	+0.382	24.3	2

Curvature Cor. +0.0008 mm.

Weighted mean	+27.0	Mean +27.1
V_a	−10.03	
V_d	+ 0.09	
Reduction to Sun	− 9.94	
Radial Velocity	+17.1 km.	

γ *ORIONIS*—B 262

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 35.003	4341.413	+0.117	....	4341.530			
S 34.936	4340.873	....	+0.119	4340.634	+0.358	+24.7	1
Ti 40.467	Standard	±0.000	....	4387.007			
S 40.633	4388.443	....	±0.000	4388.100	+0.343	23.4	2
Ti 44.988	4427.267	−0.001	....	4427.266			
S 46.158	4438.088	....	−0.017	4437.718	+0.353	23.8	½
Ti 46.420	4440.535	−0.020	....	4440.515			
Ti 49.092	4465.995	−0.020	....	4465.975			
S 49.729	4472.204	....	−0.013	4471.676	+0.515	31.5	2
Ti 50.666	Standard	±0.000	....	4481.438			
S 50.690	4481.676	....	±0.000	4481.400	+0.276	18.5	1
Ti 57.498	4552.615	+0.017	....	4552.632			
S 57.553	4553.212	....	+0.019	4552.750	+0.481	31.7	1½
Ti 57.774	4555.635	+0.027	....	4455.662			
S 58.936	4568.509	....	+0.018	4567.950	+0.577	37.9	1
S 59.550	4575.402	....	+0.011	4574.900	+0.513	33.6	½
Ti 60.843	Standard	±0.000	....	4590.126			
S 60.963	4591.507	....	−0.001	4591.066	+0.410	28.7	½
Ti 67.276	4667.868	−0.100	....	4667.768			
Ti 69.689	4699.101	−0.155	....	4698.946			
Ti 70.551	4710.558	−0.190	....	4710.368			
S 70.807	4713.992	....	−0.201	4713.308	+0.483	30.7	1

Curvature Cor. +0.001 mm.

Weighted mean	+28.9	Mean +28.8
V_a	−10.03	
V_d	+ 0.09	
Reduction to Sun	− 9.94	
Radial Velocity	+19.0 km.	

γ *ORIONIS* – B 299

1902, March 13, G. M. T. $15^h 53^m$ Measured by A.
Hour angle W $3^h 58^m$ Star fair; comparison good. Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 18.2322	Standard	±0.000	....	4338.084			
S 21.8613	4367.681	....	−0.021	4367.012	+0.648	+44.5	2
Ti 21.8827	4367.860	−0.021	....	4367.839			
S 27.6440	4417.817	....	−0.062	4417.121	+0.634	43.0	1
Ti 27.6583	4417.946	−0.062	....	4417.884			
Ti 32.8061	Standard	±0.000	....	4465.975			
S 33.4598	4472.321	....	+0.008	4471.676	+0.653	43.8	2
Ti 34.3868	4481.420	+0.018	....	4481.438			
S 34.4508	4482.052	....	+0.018	4481.400	+0.670	44.8	1
Ti 42.2737	4563.904	+0.035	....	4563.939			
S 42.6999	4568.637	....	+0.022	4567.950	+0.709	46.5	2
Ti 43.0140	4572.145	+0.011	....	4572.156			
Ti 44.6012	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm. Weighted mean +44.7 Mean +44.5

V_a −28.63
V_d − 0.29

Reduction to Sun −28.92
Radial Velocity +15.8 km.

γ *ORIONIS*—B 317

1902, April 9, G. M. T. $15^h 4^m$ Measured by A.
Hour angle W $4^h 56^m$ Star too weak; comparison strong. Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 22.9221	Standard	±0.000	....	4387.007			
S 23.1170	4388.687	....	±0.000	4388.100	+0.587	+40.1	2
Ti 31.5791	4465.985	−0.010	....	4465.975			
S 32.2371	4472.376	....	−0.006	4471.676	+0.694	46.5	3
Ti 33.1599	Standard	±0.000	....	4481.438			
S 33.2137	4481.970	....	±0.000	4481.400	+0.570	38.1	1
Ti 40.0166	4552.609	+0.023	....	4552.632			
S 40.0909	4553.420	....	+0.022	4552.750	+0.692	45.6	1
Ti 43.3733	Standard	±0.000	....	4590.126			
S 43.5163	4591.766	....	±0.000	4591.066	+0.692	45.7	1

Curvature Cor. +0.0008 mm. Weighted mean +43.6 Mean +43.2

V_a −24.92
V_d − 0.33

Reduction to Sun −25.25
Radial Velocity +18.4 km.

γ *ORIONIS*—B 317

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 35.001	Standard	±0.000	....	4387.007			
S 35.188	4388.618	....	±0.000	4388.109	+0.518	+35.4	2
Ti 37.764	4411.224	+0.016	....	4411.240			
S 38.287	4415.903	....	+0.010	4415.076			1
Ti 40.294	4434.187	−0.019	....	4434.168	+0.837	+56.8	1
S 40.739	4438.303	....	−0.019	4437.718	+0.566	38.2	1
Ti 43.662	4465.993	−0.018	....	4465.975			
S 44.318	4472.368	....	−0.007	4671.676	+0.685	45.9	2
Ti 44.590	Standard	±0.000	....	4475.026			
Ti 52.100	4552.616	+0.016	....	4552.632			
Ti 52.782	4560.076	+0.026	....	4560.102			
S 53.363	4568.730	....	+0.018	4567.950	+0.798	52.4	1
Ti 55.457	Standard	±0.000	....	4590.126			

Curvature Cor. +0.001 mm. Weighted mean +44.3 Mean +45.7

V_a −24.92
V_d − 0.33

Reduction to Sun −25.25
Radial Velocity +19.0 km.

SUMMARY OF MEASURES OF γ *ORIONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 224	1901, Sept. 11	+15.4	7	......	..
A 258	Oct. 2	+15.8	7	......	..
B 221	Nov. 8	+17.0	7	+20.2	6
B 253	Nov. 27	......	..	+21.2	7
B 262	Dec. 31	+17.1	7	+19.0	10
B 299	1902, Mar. 13	+15.8	5	......	.
B 317	Apr. 9	+18.4	5	+19.0	1

Mean +16.6 +20.1
Mean of 7 plates +17.6 km.
Mean of all measures +18.0 km.

7. ϵ *ORIONIS*

(R. A. = $5^h\ 31^m$; Dec. = $-1°\ 16'$; Mag. 1.8; Class II*a*)

Four plates of this star have been measured, three by F., and four by A. All of the lines in its spectrum are extremely broad and ill-defined, and the accuracy of measurement is probably less than for any other star in the list.

ϵ *ORIONIS*—A 208

1901, September 4, G. M. T. $22^h\ 10^m$ — Measured by A.
Hour angle E $2^h\ 23^m$ — Star rather strong; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 23.5347	Standard	±0.000	....	4338.084			
Ti 34.7160	Standard	±0.000	....	4468.663			
S 34.9557	4471.762	....	±0.000	4471.676	+0.086	+5.8	2
S 35.6890	4481.331	....	+0.017	4481.400	−0.052	−3.5	2
Ti 35.6959	4581.421	+0.017	....	4481.438			
Ti 40.8525	4552.648	−0.016	....	4552.632			
S 40.8598	4552.738	....	−0.016	4552.750	−0.012	−0.8	1
Ti 41.6242	Standard	±0.000	....	4563.939			

Curvature Cor. +0.0002 mm. Weighted mean + 0.8 Mean +0.5

V_a +26.52
V_d + 0.20

Reduction to Sun +26.72
Radial Velocity +27.5 km.

ϵ *ORIONIS*—B 228

1901, November 13, G. M. T. $19^h\ 50^m$ — Measured by A.
Hour angle E $0^h\ 29^m$ — Star good; comparison strong. — Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 14.5020	4340.974	....	±0.000	4340.634	+0.340	+23.5	2
Ti 14.9362	Standard	±0.000	....	4344.451			
Ti 20.1023	4387.071	−0.064	....	4387.007			
S 20.2495	4388.328	....	−0.061	4388.100	+0.164	11.2	1½
S 29.4612	4472.034	....	−0.006	4471.676	+0.352	23.6	
Ti 30.4276	Standard	±0.000	....	4481.438			
Ti 37.3358	4552.527	+0.105	....	4552.632			
S 37.3726	4552.925	....	+0.105	4552.750	+0.280	18.4	½
Ti 38.3732	4563.827	+0.112	....	4563.939			
S 38.7533	4568.011	....	+0.111	4567.950	+0.172	11.3	1
Ti 50.5289	Standard	±0.000	....	4710.368			
S 50.7662	4713.516	....	±0.000	4713.308	+0.208	13.2	4

Curvature Cor. +0.0008 mm. Weighted mean +15.0 Mean +16.9

V_a +13.73
V_d + 0.04

Reduction to Sun +13.77
Radial Velocity +28.8 km.

ε ORIONIS—B 228

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 30.777	4340.670	....	±0.000	4340.634	+0.036	+2.5	1
Ti 30.855	Standard	±0.000	....	4341.530			
Ti 36.390	4386.945	+0.062	....	4387.007			
S 36.511	4387.982	....	+0.062	4388.100	−0.058	−4.0	1
Ti 45.122	4465.995	−0.020	....	4465.975			
S 45.734	4471.891	....	−0.016	4471.676	+0.199	+13.3	2
Ti 48.216	Standard	±0.000	....	4496.318			
Ti 53.626	4552.612	+0.020	....	4552.632			
S 53.618	4552.850	....	+0.020	4552.750	+0.120	+7.9	½
Ti 66.817	Standard	±0.000	....	4710.368			
S 67.057	4713.548	....	±0.000	4713.308	+0.240	+15.3	3

Curvature Cor. +0.001 mm. Weighted mean +10.0 Mean + 7.0

V_a +13.73
V_d + 0.04

Reduction to Sun +13.77
Radial Velocity +23.8 km.

ε ORIONIS—B 298

1902, March 13, G. M. T. 15h 11m
Hour angle W 3h 8m

Star rather weak; comparison good.

Measured by A.
Power 14

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 17.9470	Standard	±0.000	....	4338.084			
S 18.3666	4341.438	....	−0.004	4340.634	+0.800	+55.3	2
Ti 23.8632	4387.075	−0.068	....	4387.007			
S 24 0978	4389.096	....	−0.068	4388.100	+0.938	63.4	2
Ti 25.3515	4400.001	−0.066	....	4399.935			
Ti 32.7994	4468.687	−0.024	....	4468.663			
S 33.1818	4472.435	....	−0.017	4471.676	+0.742	49.8	1
Ti 34.1023	Standard	±0.000	....	4481.438			
Ti 41.9902	4563.879	+0.060	....	4563.939			
S 42.4164	4568.609	....	+0.057	4567.950	+0.716	47.0	1
S 48.5112	4639.666	....	+0.011	4638 937	+0.740	47.8	2
Ti 49.8867	Standard	±0.000	....	4656.644			

Curvature Cor. +0.0008 mm. Weighted mean +53.7 Mean +52.6

V_a −27.23
V_d − 0.25

Reduction to Sun −27.48
Radial Velocity +26.2 km.

ε ORIONIS—B 298

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 35.000	Standard	±0.000	....	4387.007			
S 35.236	4389.041	....	±0.000	4388.100	+0.941	+64.3	2
Ti 44.222	4471.442	−0.034	....	4471.408			
S 44.308	4472.280	....	−0.031	4471.676	+0.573	38.4	2
Ti 45.241	Standard	±0.000	....	4481.438			
Ti 52.100	4552.603	+0.029	....	4552.632			
S 52.199	4553.683	....	+0.029	4552.750	+0.962	63.4	½
Ti 53.129	4563.901	+0.038	....	4563.939			
S 53.574	4568.840	....	+0.039	4567.950	+0.929	61.0	½
Ti 55.455	4590.082	+0.014	....	4590.126			
Ti 61.024	Standard	±0.000	....	4656.644			

Curvature Cor. +0.001 mm. Weighted Mean +53.5 Mean +56.8

V_a −27.23
V_d − 0.25

Reduction to Sun −27.48
Radial Velocity +26.1 km.

ϵ *ORIONIS*—B 316

1902, April 9. G. M. T. $14^h\ 21^m$ — Measured by A.
Hour angle W $4^h\ 8^m$ — Star fair; comparison good. — Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 24.3317	Standard	±0.000	....	4338.084			
S 24.7620	4341.517	....	±0.000	4340.634	+0.883	+61.1	1
Ti 30.2485	4387.016	−0.009	....	4387.007			
S 30.4698	4388.921	....	−0.009	4388.100	+0.812	55.5	1
Ti 31.7366	Standard	±0.000	....	4399.935			
Ti 39.1836	4468.671	−0.008	....	4468.663			
S 39.5633	4472.370	....	−0.006	4471.676	+0.688	46.1	3
Ti 40.4855	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm. Weighted mean +51.0 Mean +54.2

V_a −24.24
V_d − 0.30

Reduction to Sun −24.54
Radial Velocity +26.5 km.

ϵ *ORIONIS*—B 316

Measured by F.
Power 12

Ti 35.001	Standard	±0.000	....	4387.007			
S 35.213	4388.835	....	±0.000	4388.100	+0.735	+50.2	1
Ti 43.659	4466.001	−0.026	....	4465.975			
S 44.327	4472.489	....	−0.018	4471.676	+0.795	53.3	2
Ti 45.239	4481.444	−0.006	....	4481.438			
Ti 48.354	Standard	±0.000	....	4512.906			
Ti 53.127	4563.915	+0.024	....	4563.939			
S 53.562	4568.742	....	+0.015	4567.950	+0.807	53.0	½
Ti 55.456	4590.129	−0.003	....	4590.126			
Ti 61.022	Standard	±0.000	....	4656.644			

Curvature Cor. +0.001 mm. Weighted mean +52.4 Mean +52.2

V_a −24.21
V_d − 0.30

Reduction to Sun −24.51
Radial Velocity +27.8 km.

SUMMARY OF MEASURES OF ϵ *ORIONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 208	1901, Sept. 4	+27.5	3	......	..
B 228	Nov. 13	+28.8	6	+23.8	5
B 298	1902, March 13	+26.2	5	+26.1	4
B 316	April 9	+26.5	3	+27.8	3
	Mean	+27.2		+25.9	

Mean of 4 plates +26.8 km.
Mean of all measures +26.7 km.

8. ζ *ORIONIS*

(R. A. = $5^h\ 36^m$; Dec. = − 2° 0′; Mag. 1.9; Class II*b*)

Five plates of this star have been measured, five by A., and two by F. The spectrum is extremely difficult of measurement, the lines being few in number, and extremely broad and ill defined. The degree of accuracy attained is probably about the same as in the case of ϵ *Orionis*.

ζ ORIONIS—A 263

1901, October 3, G. M. T. 20h 42m
Hour angle E 1h 56m

Star strong; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.3208	Standard	±0.000	....	4338.084			
S 21.5491	4340.513	....	±0.000	4340.634	−0.121	− 8.4	2
Ti 24.0571	4367.836	+0.003	....	4367.839			
Ti 25.7550	4387.026	−0.019	....	4387.007			
S 25.8352	4387.947	....	−0.017	4388.100	−0.170	11.6	3
Ti 26.8690	Standard	±0.000	....	4399.935			
Ti 29.1549	4427.249	+0.017	....	4427.266			
S 29.9907	4437.524	....	+0.013	4437.718	−0.181	12.2	2
Ti 32.4466	4468.655	+0.008	....	4468.663			
S 32.6629	4471.467	....	+0.006	4471.676	−0.203	13.6	2
Ti 33.4230	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0002 mm. Weighted mean −11.5 Mean −11.2

V_a +25.58
V_d + 0.17

Reduction to Sun +25.75
Radial Velocity +14.3 km.

ζ ORIONIS—A 263

Measured by F.
Power 12

Ti 31.0582	Standard	±0.000	....	4338.084			
S 31.2891	4340.543	....	−0.002	4340.634	−0.093	−6.4	1
Ti 36.6062	4399.977	−0.042	....	4399.935			
Ti 42.1840	4468.668	−0.005	....	4468.663			
S 42.4116	4471.623	....	−0.004	4471.676	−0.057	3.8	1
Ti 43.1606	Standard	±0.000	....	4481.438			
Ti 49.0647	Standard	±0.000	....	4563.939			

Curvature Cor. +0.0003 mm. Weighted mean −5.1 Mean −5.1

V_a +25.58
V_d + 0.17

Reduction to Sun +25.75
Radial Velocity +20.8 km.

ζ ORIONIS—B 429

1902, October 23, G. M. T. 23h 45m
Hour angle W 2h 25m

Star good; comparison weak.

Measured by A.
Power 21

Ti 21.1865	Standard	±0.000	....	4338.084			
S 21.5038	4340.609	....	±0.000	4340.634	−0.025	−1.7	1
S 27.2283	4387.981	....	±0.000	4388.100	−0.119	8.1	1
Ti 28.0643	Standard	±0.000	....	4395.201			
S 30.3115	4415.012	....	+0.006	4415.076	−0.058	3.9	1
Ti 31.6671	4427.256	+0.010	....	4427.266			
Ti 36.0733	Standard	±0.000	....	4468.663			
S 36.3683	4471.527	....	±0.000	4471.676	−0.149	10.0	1

Curvature Cor. +0.0008 mm. Weighted mean −5.9 Mean − 5.9

V_a +21.40
V_d − 0.20

Reduction to Sun +21.20
Radial Velocity +15.3 km.

ζ ORIONIS — B 433

1902, October 29, G. M. T. $19^h\ 4^m$
Hour angle E $1^h\ 52^m$

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.3584	Standard	±0.000	....	4338.084			
S 21.6687	4340.560	....	±0.000	4340.631	−0.074	−5.1	2
S 21.9074	4366.995	....	+0.001	4367.012	−0.013	−0.9	2
S 27.4009	4388.120	....	+0.007	4388.100	+0.027	+1.8	1
Ti 28.2178	4395.193	+0.008	....	4395.201			
Ti 28.7605	Standard	±0.000	....	4399.935			
S 32.8392	4437.701	....	+0.015	4437.718	−0.002	−0.1	2
Ti 33.6183	4443.959	+0.017	....	4443.976			
Ti 36.2091	4468.670	−0.007	....	4468.663			
S 36.5151	4471.647	....	−0.005	4471.676	−0.034	−2.3	2
Ti 37.5123	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm.

Weighted mean − 1.6 Mean −0.7

V_a +19.67
V_d + 0.16

Reduction to Sun +19.83
Radial Velocity +18.2 km.

ζ ORIONIS — B 434

1902, October 29, G. M. T. $19^h\ 45^m$
Hour angle E $1^h\ 12^m$

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 20.1420	Standard	±0.000	....	4338.084			
S 20.4650	4340.662	....	±0.000	4340.634	+0.028	+ 1.9	1
S 26.1626	4387.943	....	−0.003	4388.100	−0.160	−10.9	1
Ti 27.0014	4395.205	−0.004	....	4395.201			
Ti 27.5428	Standard	±0.000	....	4399.935			
Ti 34.9950	4468.682	−0.019	....	4468.663			
S 35.3017	4471.665	....	−0.015	4471.676	−0.026	− 1.7	3
Ti 36.2973	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm.

Weighted mean − 2.9 Mean −3.6

V_a +19.66
V_d + 0.11

Reduction to Sun +19.77
Radial Velocity +16.9 km.

ζ ORIONIS — B 441

1902, October 30, G. M. T. $21^h\ 19^m$
Hour angle W $0^h\ 27^m$

Star strong; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 20.3207	Standard	±0.000	....	4338.084			
S 20.6480	4340.692	....	±0.000	4340.634	+0.058	+ 4.0	1
S 26.3658	4388.067	....	+0.001	4388.100	−0.032	− 2.2	1
Ti 27.1909	4395.200	+0.001	....	4395.201			
Ti 27.7336	Standard	±0.000	....	4399.935			
Ti 35.1942	4468.676	−0.013	....	4468.663			
S 35.4940	4471.589	....	−0.010	4471.676	−0.097	− 6.5	1
Ti 36.4981	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm.

Weighted mean − 1.6 Mean −1.6

V_a +19.31
V_d − 0.04

Reduction to Sun +19.27
Radial Velocity +17.7 km.

ζ *ORIONIS*—B 441

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 30.1739	Standard	±0.000	....	4338.084			
S 30.5197	4340.840	....	±0.000	4340.634	+0.206	+14.2	1
Ti 33.8288	4367.844	−0.005	....	4367.839			
S 36.2503	4388.347	....	−0.022	4388.100	+0.225	15.4	1
Ti 37.5895	4399.968	−0.033	....	4399.935			
S 39.5276	4417.155	....	−0.026	4417.121	+0.008	0.5	2
Ti 39.6117	4417.910	−0.026	....	4417.884			
Ti 45.0495	Standard	±0.000	....	4468.663			
S 45.3616	4471.692	....	±0.000	4471.676	+0.016	1.1	2
Ti 54.9951	Standard	±0.000	....	4572.156			

Curvature Cor. +0.0013 mm. Weighted mean + 5.5 Mean +7.8

V_a +19.31
V_d − 0.04

Reduction to Sun +19.27
Radial Velocity +24.7 km.

Summary of Measures of ζ *ORIONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 263	1901, Oct. 3	+14.3	4	+20.6	2
B 429	1902, Oct. 23	+15.3	4	......	..
B 433	Oct. 29	+18.2	5	......	..
B 434	Oct. 29	+16.9	3	......	..
B 441	Oct. 30	+17.7	3	+24.7	4
	Mean	+16.5		+22.7	

Mean of 5 plates +17.8 km.
Mean of all measures +18.3 km.

9. κ *ORIONIS*

(R. A.= 5ʰ 43ᵐ; Dec.− 9° 42′; Mag. 2.2; Class II*a*)

Seven plates of the spectrum of this star have been measured, seven by A., and three by F. The spectrum is one of the most difficult of measurement of any we have encountered, all the lines being very broad and diffuse. Traces of a few oxygen lines appear.

κ *ORIONIS*—A 244

1901, September 20, G. M. T. 22ʰ 13ᵐ
Hour angle E 1ʰ 23ᵐ

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 18.0699	Standard	±0.000	....	4338.084			
S 18.3024	4340.560	....	−0.001	4340.634	−0.075	− 5.2	1
S 19.2999	4351.296	....	−0.009	4351.495	−0.208	14.3	1
S 22.5847	4387.979	....	−0.031	4388.100	−0.152	10.4	1
Ti 23.2128	4395.237	−0.036	....	4395.201			
Ti 27.2579	Standard	±0.000	....	4443.976			
Ti 29.1978	4468.656	+0.007	....	4468.663			
S 29.4133	4471.452	....	+0.008	4471.676	−0.216	14.5	1
Ti 35.3084	4552.591	+0.041	....	4552.632			
S 35.3104	4552.620	....	+0.041	4552.750	−0.089	5.9	2
Ti 36.0815	Standard	±0.000	....	4563.939			

Curvature Cor. +0.0001 mm. Weighted mean − 9.3 Mean −10.0

V_a +24.79
V_d + 0.12

Reduction to Sun +24.91
Radial Velocity +15.6 km.

κ *ORIONIS* — B 244

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 28.9995	Standard	±0.000	....	4338.084			
S 29.2247	4340.480	....	−0.002	4340.634	−0.156	−10.8	1
S 33.5033	4387.817	....	−0.040	4388.100	−0.323	−22.1	2
Ti 31.1468	4395.247	−0.046	....	4395.201			
Ti 40.1331	Standard	±0.000	....	4468.663			
S 40.3438	4471.397	....	+0.006	4471.676	−0.273	−18.3	2½
Ti 41.1082	4481.409	+0.029	....	4481.438			
Ti 46.2450	4552.632	±0.000	....	4552.632			
S 46.2533	4552.753	....	+0.003	4552.750	+0.003	+ 0.2	1
Ti 47.0149	Standard	±0.000	....	4563.939			
S 47.2816	4567.896	....	−0.011	4567.950	−0.065	− 4.3	1
Ti 47.5686	4572.179	−0.023	....	4572.156			

Curvature Cor. +0.0003 mm. Weighted mean −11.0 Mean −11.1

V_a +24.79
V_d + 0.12

Reduction to Sun +24.91
Radial Velocity +10.9 km.

κ *ORIONIS* — A 250

1901, September 26, G. M. T. 21h 26m
Hour angle E 1h 50m

Star fair; comparison rather strong.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 37.3388	Standard	±0.000	....	4387.007			
Ti 38.4583	4399.949	−0.014	....	4399.935			
S 39.7340	4415.011	....	−0.017	4415.076	−0.082	−5.6	1
Ti 40.7524	4427.285	−0.049	....	4427.266			
S 41.5911	4437.596	....	−0.022	4437.718	−0.144	9.7	1
Ti 42.5370	4449.339	−0.026	....	4449.313			
S 44.2858	4471.661	....	−0.008	4471.676	−0.023	1.5	1
S 45.0288	4481.366	....	±0.000	4481.400	−0.034	2.3	1
Ti 45.0343	Standard	±0.000	....	4481.438			
Ti 50.9555	4563.889	+0.050	....	4563.939			
S 51.2177	4567.764	....	+0.043	4567.950	−0.143	9.4	1
Ti 52.7046	Standard	±0.000	....	4590.126			

Curvature Cor. + 0.0001 mm. Weighted mean − 5.7 Mean − 5.7

V_a +24.55
V_d + 0.16

Reduction to Sun +24.71
Radial Velocity +19.0 km.

κ *ORIONIS* — B 196

1901, October 17, G. M. T. 19h 24m
Hour angle E 2h 32m

Star good; comparison strong.

Measured by A.
Power 24

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 16.8322	Standard	±0.000	....	4338.084			
S 17.1483	4340.587	....	−0.001	4340.634	−0.048	− 3.3	1
S 22.9038	4387.966	....	−0.013	4388.100	−0.147	−10.0	1
Ti 23.7479	4395.216	−0.015	....	4395.201			
Ti 29.7642	Standard	±0.000	....	4449.313			
Ti 31.8021	4468.661	+0.002	....	4468.663			
S 32.1094	4471.626	....	+0.002	4471.676	−0.048	− 3.2	3
S 33.1156	4481.424	....	±0.000	4481.400	+0.024	+ 1.6	2
Ti 36.2562	4512.913	−0.007	....	4481.438			
Ti 40.0241	4552.615	+0.017	....	4552.632			
S 40.0294	4552.669	....	+0.017	4552.750	−0.064	− 4.2	2
Ti 41.0622	Standard	±0.000	....	4563.939			

Curvature Cor. + 0.0002 mm. Weighted mean − 3.2 Mean − 4.0

V_a +21.65
V_d + 0.21

Reduction to Sun +21.86
Radial Velocity +18.7 km.

1901, October 23, G. M. T. 19h 26m
Hour angle E 2h 1m

κ ORIONIS—A 274

Star slightly weak; comparison good.

Measured by A.
Power 25

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 25.3793	4388.096	....	±0.000	4388.100	−0.004	−0.3	1
Ti 25.9954	Standard	±0.000	....	4395.201			
S 27.6771	4414.992	....	−0.042	4415.076	−0.126	8.6	1
Ti 27.9227	4417.933	−0.049	....	4417.881			
Ti 31.9962	Standard	±0.000	....	4468.663			
S 32.2265	4471.646	....	±0.000	4471.676	−0.030	2.0	2
Ti 38.8937	Standard	±0.000	....	4563.939			

Curvature Cor. +0.0002 mm. Weighted mean − 3.2 Mean −3.6

V_a +20.27
V_d + 0.17

Reduction to Sun +20.44
Radial Velocity +17.2 km.

1901, October 31, G. M. T. 20h 24m
Hour angle E 0h 31m

κ ORIONIS—A 285

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 22.9041	4340.626	....	±0.000	4340.634	−0.008	−0.6	1
Ti 23.2617	Standard	±0.000	....	4344.451			
S 25.3370	4367.114	....	−0.042	4367.012	+0.060	+4.1	1
Ti 25.4059	4367.881	−0.042	....	4367.839			
Ti 27.1045	4387.067	−0.060	....	4387.007			
S 27.1997	4388.159	....	−0.060	4388.100	−0.001	−0.1	1
Ti 31.0726	4434.195	−0.027	....	4434.168			
S 31.3647	4437.799	....	−0.030	4437.718	+0.051	+3.4	2
Ti 32.2905	4449.349	−0.036	....	4449.313			
Ti 33.5961	Standard	±0.000	....	4465.975			
S 34.0413	4471.737	....	−0.009	4471.676	+0.052	+3.5	2
Ti 34.7844	4481.462	−0.024	....	4481.438			
Ti 39.9215	4552.599	+0.033	....	4552.632			
S 39.9269	4552.677	....	+0.033	4552.750	−0.040	−2.6	2
Ti 40.6932	4563.914	+0.025	....	4563.939			
S 40.9627	4567.906	....	+0.019	4567.950	−0.025	−1.6	2
Ti 42.4365	Standard	±0.000	....	4590.126			
S 42.4965	4591.045	....	±0.000	4591.066	−0.021	−1.4	2

Curvature Cor. +0.0005 mm. Weighted mean + 0.5 Mean +0.6

V_a +18.06
V_d + 0.04

Reduction to Sun +18.10
Radial Velocity +18.6 km.

κ ORIONIS—A 285

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 29.9333	4338.076	+0.008	....	4338.084			
S 30.1773	4340.739	....	+0.005	4340.634	+0.110	+7.6	1
Ti 30.5306	Standard	±0.000	....	4344.451			
Ti 34.3743	4387.069	−0.062	....	4387.007			
S 34.4627	4388.083	....	−0.061	4388.100	−0.078	−5.3	2
Ti 40.8675	4465.978	−0.003	....	4465.975			
S 41.3154	4471.774	....	+0.002	4471.676	+0.106	+7.1	2
Ti 42.0540	Standard	±0.000	....	4481.438			
Ti 47.1927	4552.572	+0.060	....	4552.632			
S 47.1932	4552.579	....	+0.060	4552.750	−0.111	−7.3	3
Ti 51.8296	4623.251	+0.028	....	4623.279			
Ti 52.2205	Standard	±0.000	....	4629.521			
S 52.2994	4630.792	....	±0.000	4630.703	+0.089	+5.8	1

Curvature Cor. +0.0010 mm. Weighted mean − 0.6 Mean +1.6

V_a +18.06
V_d + 0.04

Reduction to Sun +18.10
Radial Velocity +17.5 km.

κ *ORIONIS* — B 297

1902, March 13, G. M. T. $14^h 29^m$ — Hour angle W $2^h 14^m$ — Star good; comparison good. — Measured by A. Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 21.8680	4367.614	....	±0.000	4367.012	+0.602	+41.3	1
Ti 21.8949	Standard	±0.000	....	4367.839			
Ti 24.1605	4387.044	−0.037	....	4387.007			
S 24.3606	4388.767	....	−0.037	4388.100	+0.630	43.1	1
Ti 33.0949	Standard	±0.000	....	4468.663			
S 33.4630	4472.243	....	±0.000	4471.676	+0.567	38.0	2
Ti 34.3997	4481.437	+0.001	....	4481.438			
S 34.4740	4482.172	....	+0.001	4181.400	+0.773	51 7	1
Ti 41.2577	4552.608	+0.024	....	4552.632			
S 41 3312	4553.410	....	+0.024	4552.750	+0.684	45.0	2
Ti 43.0268	4572.147	+0.009	....	4572.156			
S 43.3334	4575.586	....	+0.009	4574.900	+0.693	45.4	1
Ti 44.6144	Standard	±0.000	....	4590.126			
S 45.2168	4597.061	....	±0.000	4596.291	+0.770	50.2	1

Curvature Cor. +0.0008 mm. — Weighted mean +44.2 — Mean +45.0

V_a −25.04
V_d − 0.19

Reduction to Sun −25.23
Radial Velocity +19.0 km.

κ *ORIONIS* — B 315

1902, April 9, G. M. T. $13^h 47^m$ — Hour angle W $3^h 21^m$ — Star good; comparison good. — Measured by A. Power 17

Ti 19.6236	Standard	±0.000	....	4338.084			
S 20.0091	4341.163	....	−0.002	4340.634	+0.527	+36.4	1
S 21.1303	4350.203	....	−0.007	4349.541	+0.655	45.2	1
Ti 26.4865	4395.234	−0.033	....	4395.201			
S 29.0385	4417.825	....	−0.051	4417.121	+0.653	44.3	1
Ti 29.0507	4417.935	−0.051	....	4417.884			
Ti 34.4790	Standard	±0.000	....	4468.663			
S 31.8421	4472.193	....	+0.007	4471.676	+0.521	35.1	4
Ti 35.7819	4481.414	+0.024	....	4481.438			
S 35.8385	4181.973	....	+0.024	1481.400	+0.597	40.0	1
Ti 42.6415	4552.582	+0.050	....	4552.632			
S 42.7170	4553.406	....	+0.050	4552.750	+0.706	46.5	2
Ti 43.6705	4563.884	+0.055	....	4563.939			
S 46.1285	4591.592	....	+0.037	4591.066	+0.563	36.8	1
Ti 48.3430	Standard	±0 000	....	4617.452			

Curvature Cor. +0.0008 mm. — Weighted mean +39.6 — Mean +40.6

V_a −22.86
V_d − 0.26

Reduction to Sun −23.12
Radial Velocity +16.5 km.

κ *ORIONIS* — B 315

Measured by F. Power 12

Ti 30.0110	Standard	±0.000	....	4338.084			
S 30.4000	4341.189	....	±0.000	4340.634	+0.555	+38.3	1
Ti 36.8741	4395.214	−0.013	....	4395.201			
Ti 44.8695	Standard	±0.000	....	4468.663			
S 45.2435	4472.300	....	+0.006	4471.676	+0.630	42.2	3
Ti 46.1721	4481 413	+0.025	....	4481.438			
S 46.2375	4482.083	....	+0 024	4481.400	+0 683	45.7	1
Ti 53.0331	4552.627	+0.005	....	4552 632			
S 53.0968	4553.322	....	+0 005	4552.750	+0.577	38.0	1
Ti 51.0610	4563.923	+0 016	....	4563.939			
S 51.4791	4568.568	....	+0.007	4567.950	+0 625	41.0	2
Ti 54.8003	Standard	±0 000	....	4572.156			

Curvature Cor. +0.0013 mm. — Weighted mean +41.4 — Mean +41.0

V_a −22.86
V_d − 0.26

Reduction to Sun −23.12
Radial Velocity +18.2 km.

SUMMARY OF MEASURES OF κ *ORIONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 244	1901, Sept. 20	+15.6	5	+10.9	5
A 250	Sept. 26	+19.0	5	......	..
B 196	Oct. 17	+18.7	5	......	..
A 274	Oct. 23	+17.2	3	......	..
A 285	Oct. 31	+18.6	8	+17.5	5
B 297	1902, March 13	+19.0	7	......	..
B 315	April 9	+16.5	7	+18.2	5

Mean +17.8 +15.5

Mean of 7 plates +17.5 km.

Mean of all measures +17.1 km.

10. β *CANIS MAJORIS*

(R. A.=6^h 18^m; Dec.=−17°54′; Mag. 2.0; Class III*a*)

Three plates of this star have been measured, two by A., and three by F. Numerous lines of oxygen and nitrogen are present in the spectrum in addition to the regular *Orion* lines, and all are narrow and well defined in character.

β *CANIS MAJORIS* — A 287

1901, October 31, G. M. T. 21^h 35^m Star fair; comparison good. Measured by A.
Hour angle W 0^h 9^m Power 25

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 20.5223	Standard	±0.000	....	4344.451			
S 20.6539	4345.866	....	−0.002	4345.677	+0.187	+12.9	1
S 21.0230	4349.850	....	−0.008	4349.541	+0.301	20.7	½
S 21.1914	4351.676	....	−0.011	4351.495	+0.170	11.7	½
S 22.6035	4367.197	....	−0.036	4367.012	+0.149	10.2	½
Ti 22.6645	4367.876	−0.037	....	4367.839			
Ti 26.4383	4411.311	−0.071	....	4411.240			
S 26.7735	4415.310	....	−0.083	4415.076	+0.151	10.3	2
S 26.9511	4417.438	....	−0.090	4417.121	+0.227	15.4	½
Ti 26.9959	4417.976	−0.092	....	4417.884			
Ti 30.8583	4466.035	−0.060	....	4465.975			
S 31.3058	4471.956	....	−0.037	4471.676	+0.243	16.3	2
Ti 32.0405	Standard	±0.000	....	4481.438			
Ti 37.1801	4552.558	+0.074	....	4552.632			
S 37.2029	4552.890	....	+0.074	4552.750	+0.214	14.1	2
Ti 37.9534	4563.885	+0.054	....	4563.939			
S 38.2383	4568.101	....	+0.053	4567.950	+0.204	13.4	1
Ti 38.5072	4572.103	+0.053	....	4572.156			
S 38.7063	4575.080	....	+0.056	4574.900	+0.236	15.5	2
Ti 39.6951	4590.041	+0.085	....	4590.126			
Ti 41.4542	4617.406	+0.046	....	4617.452			
S 42.2972	4630.872	....	+0.036	4630.703	+0.205	13.3	½
S 42.8130	4639.228	....	+0.029	4638.937	+0.320	20.7	1
S 42.9915	4642.140	....	+0.027	4641.886	+0.281	18.2	½
S 43.5376	4651.119	....	+0.020	4650.925	+0.214	13.8	½
Ti 43.8696	4656.628	+0.016	....	4656.644			
Ti 44.5340	Standard	±0.000	....	4667.768			
S 45.0520	4676.563	....	±0.000	4676.290	+0.273	17.5	½

Curvature Cor. +0.0005 mm. Weighted mean +14.7 Mean +14.9

V_a +18.84

V_d − 0.01

Reduction to Sun +18.83

Radial Velocity +33.5 km.

β CANIS MAJORIS — A 287

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 30.9422	4367.190	....	±0.000	4367.072	+0.118	+ 8.1	1
Ti 31.0005	Standard	±0.000	....	4367.839			
Ti 32.7005	4387.060	−0.053	....	4387.007			
S 32.8075	4388.289	....	−0.052	4388.100	+0.137	9.4	2
S 35.1105	4415.306	....	−0.060	4415.076	+0.170	11.5	2
S 35.2828	4417.372	....	−0.061	4417.121	+0.190	12.9	1
Ti 35.3308	4417.945	−0.061	....	4417.884			
Ti 39.1925	4466.018	−0.043	....	4465.975			
S 39.6468	4471.900	....	−0.028	4471.676	+0.196	13.1	2
Ti 40.3755	Standard	±0.000	....	4481.438			
S 40.3815	4481.517	....	±0.000	4481.400	+0.117	7.8	1
Ti 45.5175	4552.620	+0.012	....	4552.632			
S 45.5428	4552.988	....	+0.012	4552.750	+0.250	16.5	3
Ti 46.2862	4563.883	+0.056	....	4563.939			
S 46.5748	4568.156	....	+0.027	4567.950	+0.233	15.3	2
Ti 46.8430	4572.149	+0.007	....	4572.156			
S 47.0142	4575.159	....	+0.006	4574.900	+0.265	17.4	1
Ti 48.0330	Standard	±0.000	....	4590.126			
S 48.4478	4596.491	....	+0.001	4596.291	+0.204	13.3	1
Ti 49.7885	4617.445	+0.007	....	4617.452			

Weighted mean +12.9   Mean +12.5
Curvature Cor. − 0.71

V_a +18.84
V_d − 0.03

Reduction to Sun +18.81
Radial Velocity +31.0 km.

β CANIS MAJORIS—A 293

1901, November 1, G. M. T. $21^h\,26^m$
Hour angle W $0^h\,3^m$

Star fair; comparison good.

Measured by F.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 27.1717	Standard	±0.000	....	4338.084			
S 27.4256	4340.791	....	−0.005	4340.634	+0.152	10.5	1
S 31.7221	4388.419	....	−0.062	4388.100	+0.257	17.6	2
Ti 32.3148	4395.270	−0.069	....	4395.201			
Ti 32.7200	4399.998	−0.063	....	4399.935			
S 34.0175	4415.363	....	−0.064	4415.076	+0.223	15.2	2
S 34.1961	4417.503	....	−0.063	4417.121	+0.319	21.6	1
Ti 34.2324	4417.939	−0.055	....	4417.884			
Ti 35.0081	4427.332	−0.066	....	4427.266			
Ti 38.3000	4468.695	−0.032	....	4468.663			
S 38.5196	4471.936	....	−0.009	4471.676	+0.251	16.8	2
Ti 39.2752	Standard	±0.000	....	4481.438			
Ti 44.4088	4552.552	+0.080	....	4552.632			
S 44.4375	4552.971	....	+0.062	4552.750	+0.286	18.8	4
Ti 45.1813	4563.881	+0.058	....	4563.939			
S 45.4705	4568.169	....	+0.067	4567.950	+0.286	18.8	3
Ti 45.7311	4572.099	+0.057	....	4572.156			
S 46.9983	4591.222	....	+0.064	4591.066	+0.220	14.4	2
Ti 48.6788	4617.416	+0.036	....	4617.452			
S 50.0322	4639.181	....	+0.025	4639.206	+0.260	16.8	2
S 50.6555	4649.413	....	+0.011	4649.424	+0.184	11.9	2
Ti 51.0913	Standard	±0.000	....	4656.644			

Weighted mean +17.1   Mean +16.2
Curvature Cor. − 0.86

V_a +18.63
V_d 0.00

Reduction to Sun +18.63
Radial Velocity +34.8 km.

β CANIS MAJORIS—B 215

1901, November 7, G. M. T. 21^h 00^m — Measured by A.
Hour angle, E 0^h 8^m — Star weak; comparison slightly weak. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 15.9494	Standard	±0.000	....	4313.034			
S 16.5293	4317.457	....	−0.005	4317.272	+0.180	+12.5	2
S 16.8567	4319.969	....	−0.007	4319.762	+0.200	13.9	½
Ti 19.1827	4338.108	−0.024	....	4338.084			
S 19.5305	4340.866	....	−0.036	4340.634	+0.196	13.5	½
S 20.6401	4349.745	....	−0.050	4349.541	+0.154	10.6	1
S 20.8818	4351.696	....	−0.052	4351.495	+0.145	10.3	½
S 22.7898	4367.308	....	−0.083	4367.012	+0.213	14.6	½
Ti 22.8641	4367.923	−0.084	....	4367.839			
Ti 27.9241	4411.280	−0.040	....	4411.240			
S 28.3726	4415.264	....	−0.034	4415.076	+0.154	10.5	2
S 28.6063	4417.349	....	−0.031	4417.121	+0.197	13.4	1
S 30.8757	4437.941	....	+0.001	4437.718	+0.224	15.1	1
Ti 31.5267	4443.966	+0.010	....	4443.976			
Ti 34.1367	Standard	±0.000	....	4468.663			
S 34.4710	4471.890	....	+0.003	4471.676	+0.217	14.6	1
Ti 35.4497	4481.428	+0.010	....	4481.438			
S 42.3849	4552.929	....	+0.105	4552.750	+0.284	18.7	2
Ti 42.6262	4555.548	+0.114	....	4555.662			
Ti 43.3830	4563.823	+0.116	......	4563.939			
S 43.7684	4568.072	....	+0.114	4567.950	+0.236	15.5	3
Ti 44.1265	4572.043	+0.113	....	4572.156			
Ti 45.7245	4590.020	+0.106	....	4590.126			
S 45.8308	4591.232	....	+0.104	4591.066	+0.270	17.6	1
S 46.2829	4596.405	....	+0.099	4596.291	+0.213	13.9	½
Ti 48.0837	4617.366	+0.086	....	4617.452			
Ti 48.5765	4623.203	+0.076	....	4623.279			
S 49.2176	4630.863	....	+0.063	4630.703	+0.223	14.4	½
S 50.1463	4642.096	....	+0.044	4641.886	+0.254	16.4	½
S 50.7505	4649.491	....	+0.029	4649.250	+0.270	17.4	2
Ti 51.3287	4656.634	+0.010	....	4656.644			
S 51.7620	4662.029	....	+0.006	4661.728	+0.307	19.7	½
Ti 52.2197	Standard	±0.000	....	4667.768			

Curvature Cor.+0.0007 mm. — Weighted mean +14.7 — Mean +14.6

V_a +17.24
V_d + 0.01

Reduction to Sun +17.25
Radial Velocity +32.0 km.

β CANIS MAJORIS—B 215

Measured by F.
Power 12

S 29.9290	4367.244	....	±0.000	4367.072	+0.172	+11.8	1
Ti 30.0008	Standard	±0.000	....	4367.839			
Ti 32.2802	4387.024	−0.017	....	4387.007			
S 32.4325	4388.327	....	−0.015	4388.100	+0.212	14.5	1
S 35.5175	4415.274	....	−0.026	4415.076	+0.172	11.7	3
S 35.7475	4417.327	....	−0.032	4417.121	+0.174	11.8	2
Ti 35.8135	4417.918	−0.031	....	4417.884			
Ti 41.2755	4468.650	+0.013	....	4468.663			
S 41.6092	4471.874	....	+0.010	4471.676	+0.208	13.9	2
Ti 42.5900	Standard	±0.000	....	4481.438			
S 42.5958	4481.498	....	±0.000	4481.400	+0.098	6.6	1
Ti 43.3002	4488.445	+0.048	....	4488.493			
Ti 49.4875	4552.585	+0.047	....	4552.632			
S 49.5212	4552.951	....	+0.047	4552.750	+0.248	16.3	3
Ti 50.5230	4563.894	+0.045	....	4563.939			
S 50.9108	4568.173	......	+0.035	4567.950	+0.258	16.9	2
Ti 51.2672	4572.128	+0.028	....	4572.156			

β CANIS MAJORIS—B 215—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 51.5355	4575.120	....	+0.023	4574.900	+0.243	+15.9	1½
Ti 52.8655	Standard	±0.000	....	4590.156			
S 52.9748	4591.372	....	−0.002	4591.066	+0.301	19.8	1½
S 53.4240	4596.518	....	−0.011	4596.291	+0.216	14.1	1
Ti 55.2248	4617.499	−0.047	....	4617.452			

Curvature Cor.+0.0010 mm. Weighted mean +14.2 Mean +13.2

V_a +17.24

V_d + 0.01

Reduction to Sun +17.25

Radial Velocity +31.4 km.

SUMMARY OF MEASURES OF *β CANIS MAJORIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 287	1901, Oct. 31	+33.5	15	+31.0	10
A 293	Nov. 1	......	..	+34.8	10
B 215	Nov. 7	+32.0	18	+31.4	11

Mean +32.8 +32.4

Mean of 3 plates +32.9 km.

Mean of all measures +32.6 km.

11. *ε CANIS MAJORIS*

(R. A.=6h 55m; Dec.=−28° 50′; Mag. 1.5; Class IIIa)

Three plates of this star have been measured, two by each observer. The spectrum is very similar to that of *β Canis Majoris*, but the oxygen and nitrogen lines are slightly more diffuse in character.

ε CANIS MAJORIS B 216

1901, November 7, G. M. T. 21h 51m — Measured by A. with Zeiss Comparator
Hour angle W 0h 8m — Star good; comparison fair. — Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 64.9697	Standard	±0.000	....	4338.084			
S 64.0046	4345.798	....	−0.008	4345.677	+0.113	+ 7.8	2
S 63.5142	4349.754	....	−0.012	4349.541	+0.201	13.9	2
S 61.3858	4367.214	....	−0.030	4367.012	+0.162	11.1	1
Ti 61.3070	4367.869	−0.030	....	4367.839			
S 58.8970	4388.217	....	−0.048	4388.100	+0.099	6.8	1
Ti 57.5415	4399.994	−0.059	....	4399.935			
S 55.8182	4415.236	....	−0.062	4415.076	+0.098	6.7	2
S 55.5866	4417.311	....	−0.062	4417.121	+0.128	8.7	2
Ti 55.5158	4417.946	−0.062	....	4417.884			
S 53.3280	4437.891	....	−0.014	4437.718	+0.159	10.7	2
Ti 52.6732	Standard	±0.000	....	4443.976			
Ti 50.0722	4468.693	−0.030	....	4468.663			
S 49.7430	4471.886	....	−0.020	4471.676	+0.190	12.7	3
Ti 48.7676	4481.431	+0.007	....	4481.438			
S 48.7579	4481.527	....	+0.007	4481.400	+0.134	9.0	1
Ti 41.8927	4552.600	+0.032	....	4552.632			
S 41.8694	4552.854	....	+0.032	4552.750	+0.136	9.0	1

ε CANIS MAJORIS—B 216—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 40.8595	4563.924	+0.015	....	4563.939			
S 40.4787	4568.142	....	+0.006	4567.950	+0.198	13.0	3
Ti 40.1182	4572.157	−0.001	....	4572.156			
S 39.8528	4575.126	....	−0.001	4574.900	+0.225	15.0	2
Ti 38.5281	Standard	±0.000	....	4590.126			
S 38.4293	4591.277	....	±0.000	4591.066	+0.211	13.8	1

Curvature Cor. −0.0009 mm.

Weighted mean +11.0 Mean +10.6

V_a +16.75

V_d − 0.01

Reduction to Sun +16.74

Radial Velocity +27.7 km.

ε CANIS MAJORIS—B 451

1902, November 6, G. M. T. $21^h\ 47^m$ Measured by A.

Hour angle $0^h\ 0^m$ Star good; comparison good. Power 21

Ti 20.2279	Standard	±0.000	....	4338.084			
S 20.5550	4340.695	....	−0.002	4340.634	+0.059	+ 4.1	2
S 21.1916	4345.819	....	−0.006	4345.677	+0.136	9.4	1
Ti 23.8748	4367.863	−0.024	....	4367.839			
S 26.2804	4388.287	....	−0.016	4388.100	+0.171	11.7	2
Ti 27.0796	4395.215	−0.014	....	4395.201			
Ti 27.6206	4399.947	−0.012	....	4399.935			
S 29.3356	4415.173	....	−0.021	4415.076	+0.076	5.2	2
S 29.5728	4417.306	....	−0.022	4417.121	+0.163	11.1	2
Ti 29.6393	4417.906	−0.022	....	4417.884			
Ti 30.6720	4427.282	−0.016	....	4427.266			
S 31.8242	4437.899	....	−0.008	4437.718	+0.173	11.7	2
S 32.8231	4447.239	....	−0.002	4447.163	+0.074	5.0	1
Ti 33.0430	Standard	±0.000	....	4449.313			
Ti 35.0637	4468.662	+0.001	....	4468.663			
S 35.3911	4471.849	....	−0.001	4471.676	+0.172	11.5	2
Ti 36.3682	4481.446	−0.008	....	4481.438			
S 36.3732	4481.495	....	−0.008	4481.400	+0.087	5.8	2
Ti 43.2183	4552.610	+0.022	....	4552.632			
S 43.2380	4552.825	....	+0.022	4552.750	+0.096	6.3	2
Ti 44.2484	Standard	±0.000	....	4563.939			
S 44.6250	4568.124	....	+0.003	4567.950	+0.177	11.6	2
Ti 44.9852	4572.149	+0.007	....	4572.156			
S 45.2420	4575.032	....	+0.007	4574.900	+0.139	9.1	2

Curvature Cor. +0.0008 mm.

Weighted Mean + 8.4 Mean +8.2

V_a +16.93

V_d 0.00

Reduction to Sun +16.93

Radial Velocity +25.3 km.

ε CANIS MAJORIS—B 451

Measured by F.

Power 12

Ti 30.0044	4338.045	+0.039	....	4338.084			
S 30.3391	4340.722	....	+0.036	4340.634	+0.124	+ 8.6	1
S 33.5736	4367.188	....	±0.000	4367.012	+0.176	12.1	1½
Ti 33.6515	Standard	±0.000	....	4367.839			
Ti 35.9161	4387.060	−0.053	....	4387.007			
S 36.0565	4388.263	....	−0.050	4388.100	+0.113	7.7	1½

ε *CANIS MAJORIS*—B 451—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 37.3995	4399.950	−0.015	....	4399.935			
S 39.1153	4415.186	....	−0.024	4415.076	+0.086	+ 5.8	1½
S 39.3501	4417.298	....	−0.025	4417.121	+0.152	10.3	1
Ti 39.4179	4417.909	−0.025	....	4417.884			
Ti 44.8421	4468.667	−0.004	....	4468.663			
S 45.1720	4471.874	....	−0.003	4471.676	+0.195	13.1	2
Ti 46.1459	Standard	±0.000	....	4481.438			
Ti 52.9973	4552.589	+0.043	....	4552.632			
S 53.0178	4552.812	....	+0.043	4552.750	+0.105	6.9	2
Ti 54.0282	4563.919	+0.020	....	4563.939			
S 54.4053	4568.108	....	±0.000	4567.950	+0.158	10.4	2
Ti 54.7696	4572.176	−0.020	....	4572.156			
S 55.0261	4575.054	....	−0.017	4574.900	+0.137	9.0	1
Ti 56.3537	Standard	±0.000	....	4590.126			
S 56.4464	4591.190	....	−0.001	4591.066	+0.123	8.0	½
S 56.8974	4596.386	....	−0.006	4596.291	+0.089	5.8	½
Ti 58.6974	4617.483	−0.031	....	4617.452			

Curvature Cor. +0.0013 mm. Weighted mean + 9.2 Mean +8.9

V_a	+16.93
V_d	0.00
Reduction to Sun	+16.93
Radial Velocity	+26.2 km.

ε *CANIS MAJORIS*—B 461

1902, November 19, G. M. T. 21^h 0^m
Hour angle W 0^h 2^m

Star fair; comparison fair.

Measured by F.
Power 15

Ti 29.8020	Standard	±0.000	....	4338.084			
S 33.3811	4367.283	....	−0.018	4367.012	+0.223	+15.3	1
Ti 33.4534	4367.887	−0.048	....	4367.839			
Ti 36.6624	4395.260	−0.059	....	4395.201			
Ti 37.2046	4400.000	−0.065	....	4399.935			
S 38.9310	4415.320	....	−0.066	4415.076	+0.178	12.1	1
S 39.1565	4417.347	....	−0.066	4417.121	+0.160	10.9	1
Ti 39.2231	4417.950	−0.066	....	4417.884			
Ti 44.6513	4468.706	−0.043	....	4468.663			
S 44.9806	4471.909	....	−0.033	4471.676	+0.200	13.4	3
Ti 45.9516	Standard	±0.000	....	4481.438			
S 45.9703	4481.623	....	±0.000	4481.400	+0.223	14.9	2
Ti 52.8063	4552.586	+0.046	....	4552.632			
S 52.8402	4552.955	....	+0.046	4552.750	+0.251	16.5	3
Ti 53.8358	4563.896	+0.043	....	4563.939			
S 54.2231	4568.196	....	+0.027	4567.950	+0.273	17.9	3
Ti 54.5769	4572.145	+0.011	....	4572.156			
S 54.8412	4575.109	....	+0.015	4574.900	+0.224	14.7	1
Ti 56.1625	4590.105	+0.021	....	4590.126			
S 56.7174	4596.492	....	+0.016	4596.291	+0.217	14.2	1
Ti 58.5062	Standard	±0.000	....	4617.452			

Curvature Cor. +0.0013 mm. Weighted mean +14.8 Mean +14.4

V_a	+14.74
V_d	0.00
Reduction to Sun	+14.74
Radial Velocity	+29.6 km.

Summary of Measures of ε *CANIS MAJORIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
B 216	1901, Nov. 7	+27.7	13	......	..
B 451	1902, Nov. 6	+25.3	11	+26.2	11
B 461	Nov. 19	......	..	+29.6	9

Mean +26.5 +27.9

Mean of 3 plates +27.7 km.

Mean of all measures +27.2 km.

12. η *LEONIS*

(R. A. = $10^h\ 2^m$; Dec. = +17° 15′; Mag. 3.6; Class VIIe)

Three plates of this star have been measured, three by F., and two by A. The spectrum is well advanced toward the Ia2 type, the metallic lines being numerous and well defined. The helium line λ4471 is present but weak.

η *LEONIS* — B 329

1902, April 19, G. M. T. $15^h\ 43^m$
Hour angle W $1^h\ 38^m$

Star good; comparison good.

Measured by A.
Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 35.6462	4468.637	+0.026	....	4468.663			
S 35.6874	4469.037	....	+0.026	4468.663	+0.400	+26.8	1
Ti 36.9530	Standard	±0.000	....	4481.438			
S 36.9934	4481.837	....	±0.000	4481.400	+0.437	29.2	1
Ti 37.6612	4488.474	+0.019	....	4488.493			
S 37.7913	4489.774	....	+0.015	4489.351	+0.438	29.3	1
S 38.0125	4491.990	....	+0.007	4491.570	+0.427	28.5	1
Ti 38.4433	4496.325	−0.007	....	4496.318			
S 39.6756	4508.874	....	+0.004	4508.455	+0.423	28.1	1
Ti 40.0663	4512.899	+0.007	....	4512.906			
S 40.3610	4515.949	....	+0 005	4515.508	+0.446	29.6	1
S 40.8270	4520.800	....	+0.002	4520.397	+0.405	26.9	1
Ti 41.0349	Standard	±0.000	....	4522.974			
Ti 44.0855	4555.644	+0 018	....	4555.662			
S 44.4158	4559.269	....	+0 012	4558.827	+0.454	29.9	1
Ti 45.5779	4572.166	−0.010	....	4572.156			
S 46.0019	4576.928	....	−0.007	4576.512	+0.409	26.8	1
S 46.6666	4584.453	....	−0.003	4584.018	+0.432	28.3	1
S 47.0507	4588.835	....	−0.001	4588.381	+0.453	29.6	1
Ti 47.1634	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm. Weighted mean +28.4 Mean +28.4

V_a −25.98
V_d − 0.14

Reduction to Sun −26.12

Radial Velocity + 2.3 km.

η *LEONIS*—B 329

Measured by F.
Power 18

Ti 29.0100	4344.347	+0.104	....	4344.451			
S 29.9874	4352.275	....	+0.088	4351.930	+0.433	+29.8	3
Ti 31.8642	4367.778	+0.061	....	4367.839			
S 34.0068	4385.940	....	+0.005	4385.548	+0.397	27.1	3
Ti 34.1306	4387.005	+0.002	....	4387.007			
Ti 35.0730	4395.168	+0.033	....	4395.201			

η *LEONIS*—B 329—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 35.4219	4395.594	....	+0.008	4395.201	+0.401	+27.4	2
Ti 35.6180	Standard	±0.000	....	4399.935			
S 37.5869	4417.445	....	−0.038	4416.985	+0.422	28.6	4
Ti 37.6400	4417.923	−0.039	....	4417.884			
Ti 40.4754	4443.981	−0.005	....	4443.976			
S 40.5205	4444.404	....	−0.005	4443.976	+0.423	28.5	1
Ti 42.7869	4465.979	−0.004	....	4465.975			
Ti 43.0643	4468.666	−0.003	....	4468.663			
S 43.1058	4469.069	....	−0.004	4468.663	+0.402	27.0	1
Ti 43.3467	4471.413	−0.005	....	4471.408			
Ti 44.3683	Standard	±0.000	....	4481.438			
S 44.4087	4481.837	....	±0.000	4481.400	+0.437	29.2	4
Ti 45.0789	4488.497	−0.004	....	4488.493			
S 45.2008	4489.804	....	−0.003	4489.351	+0.450	30.0	1½
S 45.4307	4492.016	....	−0.001	4491.570	+0.445	29.7	2
Ti 45.8580	4496.316	+0.002	....	4496.318			
Ti 46.3649	4501.450	−0.002	....	4501.448			
S 46.4006	4501.813	....	−0.002	4501.448	+0.363	24.2	2
S 47.0943	4508.903	....	+0.004	4508.455	+0.452	30.1	4
Ti 47.4823	4512.899	+0.007	....	4512.906			
S 47.7765	4515.943	....	+0.006	4515.508	+0.441	29.3	3
Ti 47.9931	4518.193	+0.005	....	4518.198			
S 48.2430	4520.798	....	+0.008	4520.397	+0.409	27.1	3
Ti 48.4501	4522.903	+0.011	....	4522.974			
S 48.4762	4523.236	....	+0.011	4522.802	+0.445	29.5	3
Ti 48.8799	4527.478	+0.012	....	4527.490			
Ti 50.5092	4544.849	+0.015	....	4544.864			
S 50.9943	4550.069	....	+0.018	4549.642	+0.445	29.3	3
Ti 51.2246	4552.608	+0.024	....	4552.632			
Ti 51.5027	4555.646	+0.016	....	4555.662			
S 51.5804	4556.497	....	+0.020	4556.063	+0.454	29.9	2½
S 51.8332	4559.272	....	+0.020	4558.827	+0.465	30.6	2
Ti 52.2543	4563.919	+0.020	....	4563.939			
S 52.2914	4564.330	....	+0.020	4563.939	+0.411	27.0	½
Ti 52.9953	4572.166	−0.010	....	4572.156			
S 53.0317	4572.573	....	−0.010	4572.156	+0.407	27.7	1
S 54.0862	4584.474	....	−0.004	4584.018	+0.452	29.6	3
S 54.4682	4588.831	....	−0.001	4588.381	+0.449	29.3	1
Ti 54.5813	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0011 mm.

Weighted mean	+28.8	Mean +28.6
V_a −25.98		
V_d − 0.14		
Reduction to Sun	−26.12	
Radial Velocity	+ 2.7 km.	

η *LEONIS*—B 333

1902, April 23, G. M. T. $15^h 30^m$ Measured by F.
Hour angle W $1^h 40^m$ Star excellent; comparison excellent. Power 17

Ti 27.5052	4367.774	+0.065	....	4367.839			
S 29.6488	4385.944	....	−0.004	4385.518	+0.392	+26.8	2
Ti 29.7730	4387.012	−0.005	....	4387.007			
S 30.7751	4395.695	....	−0.001	4395.201	+0.493	33.6	1
Ti 31.2597	Standard	±0.000	....	4399.935			
S 33.2344	4417.495	....	−0.037	4416.985	+0.473	32.1	2
Ti 33.2817	4417.921	−0.037	....	4417.884			
Ti 38.4304	4465.984	−0.009	....	4465.975			
S 38.7612	4469.189	....	−0.018	4468.663	+0.508	34.1	1
Ti 38.9917	4471.431	−0.023	....	4471.408			
S 39.0668	4472.163	....	−0.022	4471.676	+0.465	31.2	2
Ti 40.0117	Standard	±0.000	....	4481.438			
S 40.0542	4481.858	....	±0.000	4481.400	+0.458	30.6	4

η LEONIS—B 333—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 40.7243	4488.514	−0.021	....	4488.493			
S 40.8501	4489.770	....	−0.021	4489.351	+0.398	26.6	1
S 41.0762	4492.034	....	−0.021	4491 570	+0.443	29.6	2
Ti 41.5042	4496.339	−0.021	....	4496.318			
S 42.7410	4508.927	....	−0.019	4508.455	+0.453	30.1	3
Ti 43 1292	4512.924	−0.018	....	4512.906			
S 43.4252	4515.987	....	−0.013	4515.508	+0.466	31.0	2
Ti 43.6390	4518.207	−0.009	....	4518.198			
S 43.8952	4520.876	....	−0.010	4520.397	+0.469	31.1	2
Ti 44.0970	4522.985	−0.011	....	4522.974			
S 44.1278	4523.308	....	−0.011	4522.802	+0.495	32 8	2
S 45.9000	4542.106	....	−0.009	4541.690	+0.407	26.9	1
Ti 46.1565	4544.867	−0.003	....	4544.864			
S 46.6430	4550.132	....	+0.002	4549.612	+0.492	32.4	4
Ti 46.8719	4552.623	+0.009	....	4552.632			
Ti 47.1502	4555 662	±0.000	....	4555.662			
S 47.2269	4556.501	....	+0.004	4556.063	+0.442	29 1	2
S 47.4772	4559.248	....	+0.003	4558.827	+0.424	27.9	3
S 49.7345	4584.485	....	+0.001	4584.018	+0.468	30.6	4
S 50.1154	4588.828	....	±0.000	4588.381	+0.447	29.2	1
Ti 50.2288	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0012 mm. Weighted mean +30.4 Mean +30.3

V_a −26.84
V_d − 0.13

Reduction to Sun −26.97
Radial Velocity + 3.4 km.

η LEONIS—B 337

1902, April 30, G. M. T. 15^h 51^m
Hour angle W 2^h 28^m

Star weak; comparison good.

Measured by A.
Power 18

S 24.9032	4386.014	....	±0.000	4385.548	+0.466	+31.9	1
Ti 25.0188	Standard	±0 000	....	4387.007			
S 28.4827	4417.468	....	−0.031	4416.985	+0.452	30.7	1
Ti 28.5325	4417.916	−0 032	....	4417.884			
Ti 31.3730	4443.980	−0.004	....	4443.976			
S 31.4218	4444.437	....	−0.004	4443.976	+0.457	30.8	1
Ti 35.2720	Standard	±0 000	....	4481.438			
S 35.3186	4481.898	....	±0.000	4481.400	+0.498	33.3	1
Ti 36.0611	4489 268	−0.006	....	4489.262			
S 36.1196	4489.852	....	−0.006	4489.351	+0.495	33.1	1
S 38.0041	4508.922	....	−0.008	4508.455	+0.459	30.5	1
Ti 38.3923	4512 914	−0.008	....	4512.906			
S 38.6883	4515.973	....	−0.006	4515.508	+0.459	30.5	1
S 39.1644	4520.920	....	−0.002	4520.397	+0.521	34.6	1
Ti 39.3612	4522.975	−0.001	....	4522.974			
S 41.1705	4542.141	....	+0.005	4541.690	+0.456	30.1	1
Ti 41.4232	4544.858	+0.006	....	4544.864			
Ti 42.4196	4555.669	−0.007	....	4555.662			
S 42.4204	4555.678	....	−0.007	4555.162	+0.509	33.5	1
S 42.5113	4556.672	....	−0.007	4556.202	+0.463	30.5	1
S 44.3449	4577.015	....	−0.003	4576.512	+0.500	32.8	1
S 44.9205	4583.515	....	−0.001	4583.011	+0.503	32.9	1
S 45.0117	4584.550	....	−0.001	4584.018	+0.531	34.7	1
S 45.3939	4588.904	....	±0.000	4588.381	+0.523	34.2	1
Ti 45.5008	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm. Weighted mean +32.3 Mean +32.3

V_a −28.06
V_d − 0.20

Reduction to Sun −28.26
Radial Velocity + 4.0 km.

η *LEONIS* B 337

Measured by F. Power 18

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	k. m.	
Ti 35.1895	Standard	±0.000	....	4481.438			
S 35.2347	4481.881	....	±0.000	4481.400	+0.484	+32.4	
Ti 35.9777	4489.256	+0.006	....	4489.262			
S 36.0391	4489.868	....	+0.006	4489.351	+0.523	34.9	1
S 36.2548	4492.025	....	+0.002	4491.570	+0.457	30.5	1½
Ti 36.6810	4496.336	−0.018	....	4496.318			
Ti 37.4337	4503.928	−0.002	....	4503.926			
S 37.9226	4508.924	....	±0.000	4508.455	+0.468	31.1	2
Ti 38.3093	4512.899	+0.007	....	4512.906			
S 38.6083	4515.989	....	+0.015	4515.508	+0.500	33.2	1½
Ti 38.8188	4518.171	+0.027	....	4518.198			
S 39.0818	4520.908	....	+0.016	4520.397	+0.527	35.0	2
Ti 39.2789	4522.966	+0.008	....	4522.974			
S 39.3112	4523.303	....	+0.008	4522.802	+0.509	33.8	3
Ti 39.7103	Standard	±0.000	....	4527.490			
S 41.0903	4542.155	....	+0.019	4541.690	+0.484	32.0	1
Ti 41.3402	4544.841	+0.023	....	4544.864			
S 41.8295	4550.152	....	+0.021	4549.642	+0.510	33.6	1
Ti 42.0578	4552.613	+0.019	....	4552.632			
Ti 42.3373	4555.662	±0.000	....	4555.662			
S 42.4250	4556.621	....	+0.001	4556.063	+0.559	36.8	2
S 42.6712	4559.321	....	+0.001	4558.827	+0.498	32.8	1
Ti 42.7418	4560.097	+0.005	....	4560.102			
S 44.9301	4584.562	....	+0.001	4584.018	+0.545	35.6	2½
S 45.3072	4588.855	....	±0.000	4588.381	+0.474	31.0	1
Ti 45.4183	Standard	±0.000	....	4590.126			

Curvature Cor.+0.0009 mm. Weighted mean +33.5 Mean +33.3

V_a −28.06
V_d − 0.20

Reduction to Sun −28.26
Radial Velocity + 5.2 km.

SUMMARY OF MEASURES OF η *LEONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
B 329	1902, April 19	+2.3	11	+2.7	21
B 333	April 23	.....	..	+3.4	18
B 337	April 30	+4.1	15	+5.2	13

Mean +3.2 +3.7

Mean of 3 plates +3.5 km.
Mean of all measures +3.5 km.

13. γ *CORVI*

(R. A.=12h 11m ; Dec.=−16° 59′ ; Mag. 2.8 ; Class VI*a*)

Three plates of this star have been measured by each observer. The spectrum shows numerous very faint and broad metallic lines which are not adapted to accurate measurement. The *Mg* line λ 4481 is decidedly the best line in the spectrum.

γ *CORVI*—B 305

1902, April 2, G. M. T. $16^h 32^m$
Hour angle E $0^h 46^m$

Star fair; comparison good.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 18.6801	Standard	±0.000	....	4338.084			
S 18.9779	4340.465	....	±0.000	4340.634	−0.169	−11.7	1
S 30.9092	4443.870	....	±0.000	4443.976	−0.106	7.2	1
Ti 30.9205	Standard	±0.000	....	4443.976			
S 33.4950	4468.551	....	−0.002	4468.663	−0.114	7.6	1
Ti 33.5067	4468.665	−0.002	....	4468.663			
S 33.8066	4471.586	....	−0.002	4471.676	−0.092	6.2	2
S 34.7998	4481.346	....	−0.002	4481.400	−0.056	3.8	2
Ti 34.8093	4481.440	−0.002	....	4481.438			
S 36.7853	4501.275	....	+0.012	4501.445	−0.158	10.5	1
Ti 36.8008	4501.433	+0.012	....	4501.445			
S 42.6707	4563.813	....	±0.000	4563.939	−0.126	8.3	2
Ti 42.6820	Standard	±0.000	....	4563.939			
S 43.4095	4572.054	....	−0.038	4572.156	−0.140	9.2	2
Ti 43.4220	4572.194	−0.038	....	4572.156			

Curvature Cor. +0.0008 mm.

Weighted mean		−7.7	Mean −8.0
	V_a − 1.09		
	V_d + 0.06		
Reduction to Sun		− 1.03	
Radial Velocity		− 8.7 km.	

γ *CORVI*—B 305

Measured by F.
Power 12

S 29.7935	4367.724	....	±0.000	4367.775	−0.051	−3.5	1
Ti 29.8072	Standard	±0.000	....	4367.839			
Ti 40.9955	4468.675	−0.012	....	4468.663			
S 40.9987	4468.705	....	−0.012	4468.663	+0.030	+ 2.0	1
S 41.0797	4469.494	....	−0.014	4469.545	−0.065	− 4.4	2
Ti 41.2785	4471.430	−0.022	....	4471.408			
S 41.3001	4471.644	....	−0.022	4471.676	−0.054	− 3.6	1
S 42.2890	4481.356	....	±0.000	4481.400	−0.044	− 2.9	3
Ti 42.2973	Standard	±0.000	....	4481.438			
Ti 44.2900	4501.432	+0.013	....	4501.445			
S 44.2935	4501.468	....	+0.013	4501.445	+0.036	+ 2.4	1
Ti 45.9164	4518.177	+0.021	....	4518.198			
S 45.9395	4518.418	....	+0.021	4518.506	−0.067	− 4.4	1
Ti 48.8054	4548.909	+0.029	....	4548.938			
S 48.8760	4549.677	....	+0.029	4549.767	−0.061	− 4.0	2
S 50.1583	4563.758	....	+0.020	4563.939	−0.161	−10.6	3
Ti 50.1730	4563.919	+0.020	....	4563.939			
Ti 52.4960	Standard	±0.000	....	4590.126			

Weighted mean		−4.3	Mean −3.2
Curvature Cor.		−0.81	
	V_a −1.09		
	V_d +0.06		
Reduction to Sun		−1.03	
Radial Velocity		−6.2 km.	

γ *CORVI*—B 312

1902, April 3, G. M. T. $16^h\ 32^m$
Hour angle E $0^h\ 47^m$

Star rather weak; comparison good.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.3728	Standard	±0.000	....	4338.084			
S 21.6969	4340.594	....	±0.000	4340.634	−0.040	−2.8	1
Ti 33.6225	4443.967	+0.006	....	4443.976			
S 36.2051	4468.600	....	±0.000	4468.663	−0.063	4.2	1
Ti 36.2116	Standard	±0.000	....	4468.663			
S 37.5026	4481.313	....	+0.018	4481.400	−0.069	4.6	4
Ti 37.5134	4481.420	+0.018	....	4481.438			
S 42.6364	4533.978	....	+0.027	4534.139	−0.131	8.9	2
Ti 42.6490	4534.112	+0.027	....	4534.139			
S 45.3798	4563.772	....	+0.031	4563.939	−0.136	8.9	1
Ti 45.3921	4563.908	+0.031	....	4563.939			
S 46.1206	4572.027	....	+0.017	4572.156	−0.112	7.3	2
Ti 46.1306	4572.139	+0.017	....	4572.156			
Ti 47.7164	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm.

Weighted mean	−6.1	Mean −6.1
V_a −1.59		
V_d +0.07		
Reduction to Sun	−1.52	
Radial Velocity	−7.6 km.	

γ *CORVI*—B 312

Measured by F.
Power 12

S 29.4604	4395.183	....	+0.012	4395.286	−0.091	−6.2	1
Ti 29.4610	4395.189	+0.012	....	4395.201			
Ti 30.0034	Standard	±0.000	....	4399.935			
Ti 33.0540	4427.274	−0.008	....	4427.266			
S 33.0690	4427.411	....	−0.008	4427.420	−0.017	−1.2	1
Ti 34.8571	4443.967	+0.009	....	4443.976			
S 34.8623	4444.016	....	+0.009	4443.976	+0.049	+3.3	1
Ti 37.4455	4468.661	+0.002	....	4468.663			
S 37.4480	4468.685	....	+0.002	4468.663	+0.024	+1.6	1
S 38.7417	4481.364	....	±0.000	4481.400	−0.036	−2.4	3
Ti 38.7492	Standard	±0.000	....	4481.438			
Ti 40.7438	4501.444	+0.001	....	4501.445			
S 40.7570	4501.577	....	+0.001	4501.445	+0.133	+8.9	2
Ti 45.2619	4548.923	+0.015	....	4548.938			
S 45.3278	4549.639	....	+0.019	4549.767	−0.109	−7.2	2
S 45.5914	4552.509	....	+0.029	4552.663	−0.125	−8.2	1
Ti 45.6000	4552.603	+0.029	....	4552.632			
S 46.6158	4563.770	....	+0.023	4563.939	−0.146	−9.6	1
Ti 46.6290	4563.916	+0.023	....	4563.939			
S 47.3605	4572.064	....	+0.016	4572.156	−0.076	−5.0	1
Ti 47.3673	4572.140	+0.016	....	4572.156			
S 48.4139	4583.955	+0.006	....	4584.018	−0.057	−3.7	1
Ti 48.9541	Standard	±0.000	....	4590.126			

Weighted mean	−3.9	Mean −4.2
Curvature Cor.	−0.87	
V_a −1.59		
V_d +0.07		
Reduction to Sun	−1.52	
Radial Velocity	−6.3 km.	

γ *CORVI* — B 330

1902, April 19, G. M. T. 17h 3m
Hour angle W 0h 45m

Star good; comparison good.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 36.4469	4468.620	....	±0.000	4468.663	−0.043	− 2.9	1
Ti 36.4513	Standard	±0.000	....	4468.663			
S 37.7570	4481.457	....	+0.003	4481.400	+0.060	+ 4.9	2
Ti 37.7547	4481.435	+0.003	... ...	4481.438			
S 39.7493	4501.436	......	±0.000	4501.445	−0.009	− 0.6	1
Ti 39.7504	Standard	±0.000	......	4501.445			
S 42.8979	4534.185	... ...	−0.011	4534.139	+0.035	+ 2.3	1
Ti 42.9711	4534.964	−0.011	....	4534.953			
S 45.6353	4563.896	....	−0.002	4563.939	−0.045	− 3.0	1
Ti 45.6394	4563.941	−0.002	....	4563.939			
S 46.3747	4572.128	....	±0.000	4572.156	−0.028	− 1.8	1
Ti 46.3772	Standard	±0 000	....	4572.156			

Curvature Cor. +0.0008 mm.

Weighted mean		+0.3
V_a	−9.29	
V_d	−0.06	
Reduction to Sun		−9.35
Radial Velocity		−9.1 km.

Mean −0.3

γ *CORVI* — B 330

Measured by F.
Power 12

Ti 30.0032	Standard	±0.000	....	4427.266			
S 30.0313	4427.523	....	±0.000	4427.420	+0.103	+7.0	1
Ti 34.4000	4468.667	−0.004	....	4468.663			
S 34.4075	4468.739	....	−0.004	4468.663	+0.072	4.8	½
S 34.7232	4471.810	....	−0.003	4471.676	+0.131	8.8	½
Ti 35.7043	4481.439	−0.001	....	4481.438			
S 35.7095	4481.490	....	−0.001	4481.400	+0.089	6.0	3
Ti 37.7005	Standard	±0.000	....	4501.445			
S 37.7117	4501.558	....	±0.000	4501.445	+0.113	7.5	1
Ti 38.8196	4512.911	+0.001	....	4512.912			
Ti 42.2250	4548.961	−0.023	....	4548.938			
S 42.3124	4549.910	....	−0.015	4549.767	+0.128	8.4	1
Ti 42.5618	4552.625	+0.007	....	4552.632			
Ti 43.5924	4563.950	−0.011	....	4563.939			
S 43.5995	4564.028	....	−0.011	4563.939	+0.078	5.1	1
Ti 44.3295	Standard	±0.000	....	4572.156			
S 44.3304	4572.166	....	±0.000	4572.156	+0.010	0.7	1

Weighted mean		+5.9
Curvature Cor.		−0.86
V_a	−9.29	
V_d	−0.06	
Reduction to Sun		−9.35
Radial Velocity		−4.3 km.

Mean +6.0

SUMMARY OF MEASURES OF γ *CORVI*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
B 305	1902, April 2	−8.7	8	−6.2	9
B 312	April 3	−7.6	6	−6.3	10
B 330	April 19	−9.1	6	−4.3	8

Mean −8.4 − 5.5

Mean of 3 plates − 7.0 km.
Mean of all measures − 7.0 km.

14. *τ HERCULIS*

(R. A.= $16^h\ 17^m$; Dec.= $+46°\ 33'$; Mag. 3.9; Class V*a*)

Four plates of this star have been measured, four by A., and two by F. The spectrum is very similar to that of *β Orionis*, the lines being rather broad but fairly well defined.

τ HERCULIS—A 325

1902, February 19, G. M. T. $21^h\ 33^m$ — Measured by A.
Hour angle E $2^h\ 33^m$ — Star good; comparison good. — Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.1914	Standard	±0.000	....	4338.084			
S 21.3945	4340.276	....	±0.000	4340.634	−0.358	−24.7	2
S 25.6210	4387.718	....	±0.000	4388.100	−0.382	26.1	2
Ti 26.2596	Standard	±0.000	....	4395.201			
Ti 32.1604	4468.667	−0.004	....	4468.663			
S 32.3572	4471.260	....	−0.003	4471.676	−0.419	28.1	4
S 33.0975	4481.103	....	±0.000	4481.400	−0.297	19.9	2
Ti 33.1225	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm. Weighted mean −25.4 Mean −24.7

V_a	+11.77
V_d	+ 0.15
Reduction to Sun	+11.92
Radial Velocity	−13.5 km.

τ HERCULIS—B 295

1902, March 12, G. M. T. $22^h\ 9^m$ — Measured by A.
Hour angle E $0^h\ 45^m$ — Star good; comparison good. — Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 21.2628	Standard	±0.000	....	4338.084			
S 21.5507	4340.383	....	±0.000	4340.634	−0.253	−17.5	1
Ti 27.1712	4387.026	−0.019	....	4387.007			
S 27.2620	4387.808	....	−0.018	4388.100	−0.310	21.2	2
Ti 28.6561	Standard	±0.000	....	4399.935			
Ti 36.0928	4468.650	+0.013	....	4468.663			
S 36.3713	4471.363	....	+0.010	4471.676	−0.303	20.3	3
S 37.3580	4481.064	....	±0.000	4481.400	−0.336	22.5	4
Ti 37.3958	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0009 mm. Weighted mean −21.1 Mean −20.4

V_a	+ 9.65
V_d	+ 0.05
Reduction to Sun	+ 9.70
Radial Velocity	−11.4 km.

τ HERCULIS—B 301

1902, March 13, G. M. T. $19^h\ 36^m$ — Measured by A.
Hour angle E $3^h\ 12^m$ — Star slightly weak; comparison good. — Power 20

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 29.1733	Standard	±0.000	....	4399.935			
S 33.3328	4437.460	....	±0.000	4437.718	−0.258	−17.4	1
Ti 34.0320	Standard	±0.000	....	4443.976			
Ti 36.6224	4468.668	−0.005	....	4468.663			
S 36.9031	4471.397	....	−0.004	4471.676	−0.283	19.0	3
S 37.8874	4481.051	....	±0.000	4481.400	−0.349	23.4	3
Ti 37.9266	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm. Weighted mean − 20.6 Mean − 19.9

V_a	+9.53
V_d	+0.17
Reduction to Sun	+ 9.70
Radial Velocity	−10.9 km.

τ *HERCULIS*—B 301

Measured by F.
Power 14

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 36.1373	Standard	±0.000	....	4465.975			
S 36.6877	4471.332	....	+0.003	4471.676	−0.341	−22.9	1
Ti 36.6951	4471.405	+0.003	....	4471.408			
S 37.6728	4481.014	....	±0.000	4481.400	−0.386	−25.8	1
Ti 37.7157	Standard	±0.000	....	4481.438			
Ti 38.4255	Standard	±0.000	....	4488.493			

Curvature Cor. +0.0013 mm. Weighted mean −24.4 Mean −24.4

V_a +9.53
V_d +0.17

Reduction to Sun + 9.70
Radial Velocity −14.7 km.

τ *HERCULIS*—B 313

1902, April 3, G. M. T. 17^h 29^m
Hour angle E 3^h 58^m

Star weak; comparison fair.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 21.1901	Standard	±0.000	....	4338.084			
S 21.4742	4340.354	....	−0.001	4340.634	−0.281	−19.4	1
S 27.2043	4387.939	....	−0.026	4388.100	−0.187	12.8	1
Ti 28.0459	4395.231	−0.030	....	4395.201			
S 32.7402	4437.439	....	−0.004	4437.718	−0.283	19.1	2
Ti 33.4414	Standard	±0.000	....	4443.976			
Ti 36.0305	4468.668	−0.005	....	4468.663			
S 36.3129	4471.415	....	−0.002	4471.676	−0.263	17.6	3
S 37.2987	4481.091	....	+0.012	4481.400	−0.297	20.0	4
Ti 37.3326	4481.426	+0.012	....	4481.438			
Ti 45.2153	Standard	±0.000	....	4563.939			

Curvature Cor. + 0.0008 mm. Weighted mean −18.5 Mean −17.8

V_a +6.17
V_d +0.20

Reduction to Sun + 6.37
Radial Velocity −12.1 km.

τ *HERCULIS*—B 313

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 39.1607	Standard	±0.000	....	4468.663			
S 39.4455	4471.439	....	±0.000	4471.676	−0.237	−15.9	1
S 40.4213	4481.032	....	±0.000	4481.400	−0.368	−24.6	1
Ti 40.4623	Standard	±0.000	....	4481.438			
Ti 48.3471	4563.949	−0.010	....	4563.939			
Ti 49.0852	Standard	±0.000	....	4572.156			

Curvature Cor. + 0.0013 mm. Weighted mean −20.3 Mean — 20.3

V_a +6.17
V_d +0.20

Reduction to Sun + 6.37
Radial Velocity −13.9 km.

SUMMARY OF MEASURES OF τ *HERCULIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 325	1902, Feb. 19	−13.5	4	......	..
B 295	Mar. 12	−11.4	4	......	..
B 301	Mar. 13	−10.9	3	−14.7	2
B 313	April 3	−12.1	5	−13.9	2

Mean −12.0 −14.3

Mean of 4 plates −12.7 km.

Mean of all measures −12.7 km.

15. ζ *DRACONIS*

(R. A. = $17^h\ 7^m$; Dec. = +65° 50′; Mag. 3.3; Class V*a*)

Four plates of this star have been measured, by each observer. The spectrum contains few lines, but these, though rather broad, are better defined than in most of the stars containing them.

ζ *DRACONIS* — B 290

1902, February 3, G. M. T. $22^h\ 24^m$ Measured by A.
Hour angle E $3^h\ 42^m$ Power 21
Star good; comparison rather weak.

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 20.6686	Standard	±0.000	....	4338.084			
S 20.9577	4340.406	....	±0.000	4340.634	−0.228	−15.8	1
S 22.3687	4351.863	....	±0.000	4352.083	−0.220	15.2	1
Ti 28.0210	Standard	±0.000	....	4399.935			
S 29.9143	4416.863	....	−0.003	4417.121	−0.261	17.7	1
Ti 30.0273	4417.887	−0.003	....	4417.884			
Ti 35.4213	4468.674	−0.011	....	4468.663			
S 35.7115	4471.517	....	−0.008	4471.676	−0.167	11.2	1
S 36.6858	4481.146	....	±0.000	4481.400	−0.254	17.0	3
Ti 36.7152	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm. Weighted mean −15.8 Mean −15.4

V_a + 2.03
V_d + 0.12

Reduction to Sun + 2.15
Radial Velocity −13.7 km.

ζ *DRACONIS* — B 290

Measured by F.
Power 12

Ti 35.0010	Standard	±0.000	....	4338.084			
S 35.3010	4340.496	....	−0.001	4340.634	−0.139	− 9.6	2
Ti 42.3535	Standard	±0.000	....	4399.935			
Ti 49.7540	4468.659	+0.004	....	4468.663			
S 50.0357	4471.417	....	+0.003	4471.676	−0.256	17.2	2
S 51.0140	4481.080	....	±0.000	4481.400	−0.323	21.4	3
Ti 51.0500	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0010 mm. Weighted mean −16.5 Mean −16.1

V_a +2.03
V_d +0.12

Reduction to Sun + 2.15
Radial Velocity −14.4

ζ DRACONIS — A 314

1902, February 10, G. M. T. $22^h\ 12^m$
Hour angle E $3^h\ 24^m$

Star good; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.4626	Standard	±0.000	....	4338.084			
S 21.6748	4340.375	....	±0.000	4340.634	−0.259	−17.9	3
Ti 25.8323	4387.016	−0.009	....	4387.007			
S 25.9032	4387.842	....	−0.009	4388.100	−0.267	18.2	2
Ti 26.9314	Standard	±0.000	....	4399.935			
Ti 32.4327	4468.671	−0.008	....	4468.663			
S 32.6389	4471.388	....	−0.006	4471.676	−0.294	19.7	3
S 33.3751	4481.177	....	±0.000	4481.400	−0.223	14.9	3
Ti 33.3946	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm. Weighted mean −17.7 Mean − 17.7

V_a + 1.79
V_d + 0.11

Reduction to Sun + 1.90
Radial Velocity −15.8 km.

ζ DRACONIS — A 314

Measured by F.
Power 12

Ti 34.9934	Standard	±0.000	....	4338.084			
S 35.2065	4340.365	....	±0.000	4340.644	−0.269	−18.6	2
Ti 39.3611	4387.004	+0.003	....	4387.007			
S 39.4230	4387.717	....	+0.003	4388.100	−0.380	26.0	½
Ti 40.4611	Standard	±0.000	....	4399.935			
Ti 45.7584	4466.003	+0.028	....	4465.975			
S 46.1762	4471.499	....	+0.018	4471.676	−0.159	10.7	2
S 46.9095	4481.252	....	±0.000	4481.400	−0.148	9.9	2
Ti 46.9234	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0009 mm. Weighted mean −14.0 Mean −16.3

V_a + 1.79
V_d + 0.11

Reduction to Sun + 1.90
Radial Velocity −12.2 km.

ζ DRACONIS — A 324

1901, February 19, G. M. T. $20^h\ 33^m$
Hour angle E $4^h\ 33^m$

Star good; comparison good.

Measured by A.
Power 21

Ti 22.5708	Standard	±0.000	....	4338.084			
S 22.7874	4340.422	....	−0.001	4340.634	−0.213	−14.7	3
Ti 26.9425	4387.027	−0.020	....	4387.007			
S 27.0189	4387.916	....	−0.020	4388.100	−0.204	13.9	1
Ti 28.0410	Standard	±0.000	....	4399.935			
Ti 33.5441	4468.669	−0.006	....	4468.663			
S 33.7545	4471.441	....	−0.005	4471.676	−0.240	16.1	4
S 34.4909	4481.229	....	±0.000	4481.400	−0.171	11.4	1
Ti 34.5065	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm. Weighted Mean −14.9 Mean −14.0

V_a +1.44
V_d +0.13

Reduction to Sun + 1.57
Radial Velocity −13.3 km.

ζ *DRACONIS* — A 324

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m	t. m.	t. m.	t. m.	km.	
Ti 34.9981	Standard	±0.000	....	4338.084			
S 35.2102	4340.370	....	±0.000	4340.634	−0.264	−18.2	2
Ti 40.4686	Standard	±0.000	....	4399.935			
Ti 45.9704	4468.670	−0.007	....	4468.663			
S 46.1808	4471.442	....	−0.006	4471.676	−0.240	16.1	1½
S 46.9135	4481.185	....	±0.000	4481.400	−0.215	14.4	2
Ti 46.9324	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0009 mm.

Weighted mean −16.2 Mean −16.2

V_a +1.44
V_d +0.13

Reduction to Sun + 1.60
Radial Velocity −14.6 km.

ζ *DRACONIS* — B 357

1902, May 30, G. M. T. $16^h\ 4^m$
Hour angle E $2^h\ 27^m$

Star fair; comparison good.

Measured by A
Power 21

Ti 21.2291	Standard	±0.000	....	4338.084			
S 21.5206	4340.400	....	±0.000	4340.634	−0.234	−16.2	1
S 22.9485	4351.878	....	−0.002	4352.083	−0.207	14.3	1
Ti 24.8920	4367.843	−0.004	....	4367.839			
Ti 28.6561	Standard	±0.000	....	4399.935			
S 30.5791	4416.957	....	−0.025	4417.121	−0.189	12.8	2
Ti 30.6853	4417.910	−0.026	....	4417.884			
Ti 36.1318	4468.674	−0.011	....	4468.663			
S 36.4205	4471.476	....	−0.008	4471.676	−0.208	14.0	3
S 37.4134	4481.186	....	±0.000	4481.400	−0.214	14.3	2
Ti 37.4390	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0008 mm.

Weighted mean −14.0 Mean −14.3

V_a −2.46
V_d +0.09

Reduction to Sun − 2.37
Radial Velocity −16.4 km.

ζ *DRACONIS* — B 357

Measured by F.
Power 12

Ti 35.0914	Standard	±0.000	....	4438.084			
S 35.3767	4340.352	....	+0.004	4340.634	−0.280	−19.3	2
Ti 35.8884	4344.439	+0.012	....	4344.451			
Ti 41.0274	4387.020	−0.013	....	4387.007			
S 41.1552	4388.117	....	−0.012	4388.100	+0.005	+3.4	1
Ti 42.5201	Standard	±0.000	......	4499.935			
Ti 49.7164	4465.982	+0.007	....	4465.975			
S 50.2872	4471.507	....	+0.004	4471.676	−0.167	−11.2	3
S 51.2750	4481.173	....	±0.000	4481.400	−0.227	−15.2	3
Ti 51.3019	Standard	±0.000	....	4481.438			

Curvature Cor. + 0.0009 mm.

Weighted mean −12.7 Mean −10.6

V_a +2.46
V_d +0.09

Reduction to Sun − 2.37
Radial Velocity −15.1 km.

SUMMARY OF MEASURES OF ζ *DRACONIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
B 290	1902, Feb. 3	−13.7	5	−14.4	3
A 314	Feb. 10	−15.8	4	−12.2	4
A 324	Feb. 19	−13.3	4	−14.6	3
B 357	May 30	−16.4	5	−15.1	4

Mean −14.8 −14.1

Mean of 4 plates −14.4 km.

Mean of all measures −14.4 km.

16. ι *HERCULIS*

(R. A. = $17^h 37^m$; Dec. = +46° 4′; Mag. 3.9; Class IV *b*)

Four plates of this star have been measured, two by F., and four by A. The spectrum contains few lines, but these are well defined, and suitable for fairly accurate measurement.

ι *HERCULIS*—A 251

1901, September 27, G. M. T. $14^h 35^m$ — Hour angle W $3^h 30^m$ — Star good; comparison strong. — Measured by A. Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 26.5330	4386.994	+0.013	....	4387.007			
S 26.6174	4387.961	....	+0.012	4388.100	−0.127	−8.7	1
Ti 27.6518	Standard	±0.000	....	4399.935			
S 30.7860	4437.582	....	+0.012	4437.718	−0.124	8.4	1
Ti 31.3001	4443.962	+0.014	....	4443.976			
Ti 33.0377	4465.975	±0.000	....	4465.975			
S 33.4709	4471.573	....	±0.000	4471.676	−0.103	6.9	3
S 34.2137	4481.277	....	±0.000	4481.400	−0.123	8.2	4
Ti 34.2259	Standard	±0.000	....	4481.438			
S 39.3722	4552.574	....	+0.044	4552.750	−0.132	8.7	1
Ti 39.3732	4552.588	+0.044	....	4552.632			
Ti 40.1497	4563.950	−0.011	....	4563.939			
S 40.4149	4567.871	....	−0.010	4567.950	−0.089	5.8	2
Ti 41.8944	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0001 mm. Weighted mean − 7.6 Mean −7.8

V_a −10.06
V_d − 0.19

Reduction to Sun −10.25
Radial Velocity −17.8 km.

ι *HERCULIS*—A 260

1901, October 3, G. M. T. $15^h 30^m$ — Hour angle W $4^h 45^m$ — Star good; comparison fair. — Measured by A. Power 21

Ti 17.2714	4387.020	−0.013	....	4387.007			
S 17.3544	4387.974	....	−0.012	4388.100	−0.138	−9.4	1
Ti 18.3849	Standard	±0.000	....	4399.935			
Ti 20.6754	4427.319	−0.053	....	4427.266			
S 21.5156	4437.651	....	−0.043	4437.718	−0.110	7.4	1
S 24.1877	4471.587	....	−0.009	4471.676	−0.098	6.6	2
S 24.9277	4481.286	....	±0.000	4481.400	−0.114	7.6	2
Ti 24.9392	Standard	±0.000	....	4481.438			
Ti 30.0724	4552.642	−0.010	....	4552.632			
S 30.0713	4552.616	....	−0.010	4552.750	−0.134	8.8	1
Ti 30.2792	Standard	±0.000	....	4555.662			

Curvature Cor. +0.0001 mm. Weighted mean −7.8 Mean −8.0

V_a − 9.71
V_d − 0.22

Reduction to Sun − 9.93
Radial Velocity −17.7 km.

ι HERCULIS—A 260

Measured by F.
Power 12

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 30.0003	Standard	±0.000	....	4338.084			
S 30.2409	4340.645	....	−0.001	4340.634	+0.010	+0.7	1
Ti 34.4350	4387.038	−0.031	....	4387.007			
S 34.5245	4388.065	....	−0.030	4388.100	−0.065	−4.4	3
Ti 35.5491	4399.945	−0.010	....	4399.935			
Ti 37.8363	Standard	±0.000	....	4427.266			
S 38.6818	4437.656	....	+0.009	4437.718	−0.053	−3.6	2
Ti 39.1885	4443.961	+0.015	....	4443.976			
Ti 40.9215	4465.976	−0.001	....	4465.975			
S 41.3537	4471.579	....	+0.006	4471.676	−0.091	−6.1	4
S 42.0920	4481.255	....	+0.019	4481.400	−0.126	−8.4	4
Ti 42.1044	4481.419	+0.019	....	4481.438			
Ti 47.4434	Standard	±0.000	....	4555.662			

Weighted mean − 5.6 Mean −4.4
Curvature Cor. − 0.27
V_a −9.71
V_d −0.22
Reduction to Sun − 9.93
Radial Velocity −15.8 km.

ι HERCULIS—B 203

1901, October 18, G. M. T. $15^h\ 27^m$
Hour angle W $5^h\ 42^m$

Star weak; comparison strong.

Measured by A.
Power 24

Ti 40.3344	Standard	±0.000	....	4468.663			
S 40.6336	4471.547	....	+0.001	4471.676	−0.128	−8.6	1
S 41.6345	4481.279	....	+0.005	4481.400	−0.116	7.8	2
Ti 41.6502	4481.433	+0.005	....	4481.438			
Ti 44.7949	4512.903	+0.003	....	4512.906			
Ti 48.5741	4552.617	+0.015	....	4552.632			
S 48.5752	4552.629	....	+0.015	4552.750	−0.106	7.0	2
Ti 51.9644	Standard	±0.000	....	4590.126			
Ti 61.7980	Standard	±0.000	....	4710.368			
S 62.0145	4713.227	....	±0.000	4713.308	−0.081	5.2	3

Curvature Cor. +0.0002 mm. Weighted mean − 6.7 Mean − 7.1
V_a −8.39
V_d −0.24
Reduction to Sun − 8.63
Radial Velocity −15.3 km.

ι HERCULIS—B 203

Measured by F.
Power 12

Ti 34.9975	4386.971	+0.036	....	4387.007			
S 35.1125	4387.952	....	+0.033	4388.100	−0.115	− 7.9	2
Ti 36.5035	Standard	±0.000	....	4399.935			
Ti 37.7940	4411.248	−0.008	....	4411.240			
S 38.2090	4414.927	....	−0.009	4415.076	−0.158	10.7	½
Ti 43.7450	4465.999	−0.024	....	4465.975			
S 44.3230	4471.555	....	−0.015	4471.676	−0.136	9.1	3
S 45.3240	4481.282	....	±0.000	4481.400	−0.118	7.9	4
Ti 45.3400	Standard	±0.000	....	4481.438			

ι *HERCULIS*—B 203—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 52.2650	4552.612	+0.020	....	4552.632			
S 52.2660	4552.622	....	+0.020	4552.750	−0.108	−7.1	2
Ti 55.6550	Standard	±0.000	....	4590.126			
Ti 61.2750	4656.666	−0.022	....	4656.644			
Ti 65.4895	4710.502	−0.134	....	4710.368			
S 65.7060	4713.366	....	−0.146	4713.308	−0.088	5.6	3

Weighted mean − 7.6 Mean −8.0
Curvature Cor. − 0.18
V_a −8.39
V_d −0.24
Reduction to Sun − 8.63
Radial Velocity −16.4 km.

ι *HERCULIS*—B 403

1902, September 3, G. M. T. $17^h\ 20^m$ Measured by A.
Hour angle W $4^h\ 38^m$ Star good; comparison good. Power 17

Ti 20.9299	Standard	±0.000	....	4338.084			
S 21.2447	4340.589	....	−0.002	4340.634	−0.047	−3.3	1
Ti 26.8642	4387.044	−0.037	....	4387.007			
S 26.9867	4388.095	....	−0.035	4388.100	−0.040	2.7	3
Ti 28.3553	4399.953	−0 018	....	4399.935			
Ti 31.4156	4427.263	+0.003	....	4427.266			
S 32.5444	4437.625	....	+0.002	4437.718	−0.091	6.2	2
Ti 33.7972	Standard	±0.000	....	4449.313			
Ti 35.8235	4468.651	+0.012	....	4468.663			
S 36.1231	4471.557	....	+0.019	4471.676	−0.100	6.7	3
S 37.1156	4481.271	....	+0.043	4481.400	−0.086	5.8	4
Ti 37.1282	4481.395	+0.043	....	4481.438			
Ti 44.0047	Standard	±0.000	....	4552.632			
S 44.0054	4552.640	....	±0.000	4552.750	−0.110	7.2	3

Curvature Cor. +0.0008 mm. Weighted mean − 5.5 Mean −5.3
V_a −10.36
V_d − 0.22
Reduction to Sun −10.58
Radial Velocity −16.1 km.

SUMMARY OF MEASURES OF ι *HERCULIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 251	1901, Sept. 27	−17.8	6	......	..
A 260	Oct. 3	−17.7	5	−15.8	5
B 203	Oct. 18	−15.3	4	−16.4	6
B 403	1902, Sept. 3	−16.1	6	......	..

Mean −16.7 −16.1
Mean of 4 plates −16.6 km.
Mean of all measures −16.4 km.

17. 67 *OPHIUCHI*

(R. A. $=17^h\ 56^m$; Dec. $=+2°\ 56'$; Mag. 4.0; Class Vc)

Three plates of this star have been measured, three by A., and one by F. The lines present in the spectrum are few in number and rather diffuse in character.

67 *OPHIUCHI*—B 347

1902, May 14, G. M. T. $19^h\ 14^m$ — Measured by A.
Hour angle E $1^h\ 7^m$ — Star weak; comparison strong. — Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 26.5243	Standard	±0.000	....	4387.007			
S 26.6119	4387.761	....	±0.000	4388.100	−0.339	−23.2	2
Ti 35.1861	4465.985	−0.010	....	4465.975			
S 35.7506	4471.458	....	−0.007	4471.676	−0.225	15.1	2
S 36.7347	4481.107	....	±0.000	4481.400	−0.293	19.6	1
Ti 36.7682	Standard	±0.000	....	4481.438			
S 43.6078	4552.378	....	+0.017	4552.750	−0.355	23.1	2
Ti 43.6295	4552.615	+0.017	....	4552.632			
S 46.4328	4583.798	....	±0.000	4584.018	−0.220	14.4	1
Ti 46.9877	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm. Weighted mean −19.6 Mean − 19.1

V_a +15.51
V_d + 0.10

Reduction to Sun +15.61
Radial Velocity − 4.0 km.

67 *OPHIUCHI*—B 369

1902, June 25, G. M. T. $19^h\ 41^m$ — Measured by A.
Hour angle W $2^h\ 11^m$ — Star weak; comparison fair. — Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 33.5901	Standard	±0.000	....	4465.975			
S 34.1816	4471.703	....	±0.000	4471.676	+0.027	+1.8	1
S 35.1712	4481.391	....	+0.002	4481.400	−0.007	−0.5	3
Ti 35.1757	4481.436	+0.002	....	4481.438			
Ti 39.2693	Standard	±0.000	....	4522.974			
Ti 42.0514	4552.621	+0.011	....	4552.632			
S 42.0588	4552.702	....	+0.011	4552.750	−0.037	−2.4	2
Ti 45.4160	Standard	±0.000	....	4590.126			

Curvature Cor. + 0.0008 mm. Weighted mean −0.7 Mean − 0.4

V_a −2.19
V_d −0.18

Reduction to Sun −2.37
Radial Velocity −3.1 km.

67 *OPHIUCHI* — A 346

1902, July 7, G. M. T. $17^h 32^m$
Hour angle W $1^h 45^m$

Star good; comparison good.

Measured by A.
Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
S 27.0710	4388.094	....	±0.000	4388.100	−0.006	−0.4	2
Ti 28.0857	Standard	±0.000	....	4399.935			
Ti 33.6391	4468.668	−0.005	....	4468.663			
S 33.8791	4471.798	....	−0.005	4471.676	+0.117	+7.8	3
Ti 34.6120	4481.441	−0.003	....	4481.438			
S 34.6180	4481.521	....	−0.003	4481.400	+0.118	+7.9	4
Ti 37.9791	Standard	±0.000	....	4527.490			
S 41.2400	4575.018	....	±0.000	4574.900	+0.118	+7.7	1
Ti 47.8867	Standard	±0.000	....	4682.088			
Ti 49.5012	4710.417	−0.049	....	4710.368			
S 49.6696	4713.429	....	−0.049	4713.308	+0.072	+4.6	4

Curvature Cor. +0.0005 mm.

Weighted mean +5.7 Mean +5.5

V_a −7.38
V_d −0.15

Reduction to Sun −7.53

Radial Velocity −1.8 km.

67 *OPHIUCHI* — A 346 Measured by F. with Zeiss Comparator
Power 13

Ti 32.491	4337.977	+0.107	....	4338.084			
S 36.978	4388.069	....	+0.020	4388.100	−0.011	−0.8	2
Ti 37.992	Standard	±0.000	....	4399.935			
Ti 43.320	4466.002	−0.027	....	4465.975			
S 43.760	4471.765	....	−0.017	4471.676	+0.072	+4.8	3
Ti 44.493	Standard	±0.000	....	4481.438			
S 44.494	4481.451	....	±0.000	4481.400	+0.051	+3.4	4
Ti 45.600	4496.329	−0.011	....	4496.318			
Ti 49.587	Standard	±0.000	....	4552.632			
S 49.594	4552.735	....	±0.000	4552.750	−0.015	−1.0	½

Weighted mean +2.5 Mean +1.6

Curvature Cor. +1.41

V_a −7.38
V_d −0.15

Reduction to Sun −7.53

Radial Velocity −3.6 km.

SUMMARY OF MEASURES OF 67 *OPHIUCHI*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
B 347	1902, May 14	−4.0	5	.....	..
B 369	June 25	−3.1	3	.....	..
A 346	July 7	−1.8	5	−3.6	4

Mean −3.0 −3.6

Mean of 3 plates −3.3 km.

Mean of all measures −3.1 km.

18. 102 *HERCULIS*

(R. A. = $18^h 4^m$; Dec. = $+20°48'$; Mag. 4.5; Class IV*b*)

Four plates of this star have been measured, four by A., and one by F. The lines in the spectrum are diffuse, and not well adapted to accurate measurement.

102 *HERCULIS*—A 358

1902, July 23, G. M. T. $17^h 53^m$
Hour angle W $2^h 0^m$

Star good; comparison fair.

Measured by A.
Power 13

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 21.0816	Standard	±0.000	....	4338.084			
S 25.5751	4388.053	....	−0.015	4388.100	−0.062	−4.2	2
Ti 26.1944	4395.218	−0.017	....	4395.201			
Ti 28.8695	4427.282	−0.016	....	4427.266			
S 29.7468	4437.754	....	−0.006	4437.718	+0.030	+2.0	1
Ti 30.2141	Standard	±0.000	....	4443.976			
Ti 32.1395	4468.613	+0.050	....	4468.663			
S 32.3669	4471.582	....	+0.049	4471.676	−0.045	−3.0	2
Ti 38.2196	4552.601	+0.031	....	4552.632			
S 38.2291	4552.741	....	+0.031	4552.750	+0.022	+1.4	1
Ti 38.9877	Standard	±0.000	....	4563.939			
S 39.2607	4568.011	....	±0.000	4567.950	+0.061	+4.0	1

Curvature Cor. +0.0005 mm.

Weighted mean − 1.0 Mean 0.0

V_a −10.13
V_d − 0.16

Reduction to Sun −10.29
Radial Velocity −11.3 km.

102 *HERCULIS*—B 385

1902, August 11, G. M. T. $16^h 12^m$
Hour angle W $1^h 35^m$

Star good; comparison good.

Measured by A.
Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 21.1940	Standard	±0.000	....	4338.084			
Ti 27.1297	4387.052	−0.045	....	4387.007			
S 27.2596	4388.167	....	−0.044	4388.100	+0.023	+1.6	1
Ti 28.6223	4399.971	−0.036	....	4399.935			
S 30.5760	4417.270	....	−0.029	4417.121	+0.120	8.2	1
Ti 30.6477	4417.913	−0.029	....	4417.884			
Ti 31.6828	4427.272	−0.006	....	4427.266			
S 32.8329	4437.825	....	−0.003	4437.718	+0.104	7.0	1
Ti 34.0647	Standard	±0.000	....	4449.313			
Ti 36.0938	4468.665	−0.002	....	4468.663			
S 36.1078	4471.708	....	−0.002	4471.676	+0.030	2.0	2
S 37.4010	4481.424	....	−0.001	4481.400	+0.023	1.5	1
Ti 37.4025	4481.439	−0.001	....	4481.438			
Ti 44.2795	4552.612	+0.020	....	4552.632			
S 44.2939	4552.770	....	+0.020	4552.750	+0.040	2.6	2
Ti 45.3132	Standard	±0.000	....	4563.939			

Curvature Cor. +0.0009 mm.

Weighted mean + 3.5 Mean +3.8

V_a −15.36
V_d − 0.13

Reduction to Sun −15.49
Radial Velocity −12.0 km.

102 *HERCULIS*—B 385

Measured by F.
Power 13

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 30.0027	4337.991	+0.093	....	4338.081			
S 30.3396	4340.675	....	+0.088	4340.634	+0.129	+8.9	1
Ti 35.9388	Standard	±0.000	....	4387.007			
S 36.0675	4388.112	....	±0.000	4388.100	+0.012	+0.8	2
Ti 37.4313	4399.933	+0.002	....	4399.935			
Ti 40.4935	4427.266	±0.000	....	4327.266			
S 41.6344	4437.739	....	+0.002	4437.718	+0.023	+1.6	1
Ti 42.8747	4449.309	+0.004	....	4449.313			
Ti 45.1844	4471.387	+0.021	....	4471.408			
S 45.2204	4471.736	....	+0.021	4471.676	+0.081	+5.4	2
Ti 46.2120	Standard	±0.000	....	4481.438			
S 46.2134	4481.452	....	±0.000	4481.400	+0.052	+3.5	2
Ti 53.0896	4552.611	+0.021	....	4552.632			
S 53.1003	4552.727	....	+0.021	4552.750	−0.002	−0.1	3
Ti 56.4554	Standard	±0.000	....	4590.126			

Curvature Cor. + 0.0013 mm.

Weighted mean		+ 2.7	Mean +3.3
V_a	−15.36		
V_d	− 0.13		
Reduction to Sun		−15.49	
Radial Velocity		−12.8 km.	

1902, August 27, G. M. T. $15^h\ 0^m$
Hour angle W $1^h\ 28^m$

102 *HERCULIS*—B 397

Star too weak; comparison strong.

Measured by A.
Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 23.4654	4387.005	+0.002	....	4387.007			
S 23.6159	4388.297	....	+0.002	4388.100	+0.199	+13.6	2
Ti 24.9590	Standard	±0.000	....	4399.935			
Ti 28.0223	4427.263	+0.003	....	4427.266			
Ti 32.4369	4468.681	−0.018	....	4468.663			
S 32.7593	4471.805	....	−0.014	4471.676	+0.115	7.7	3
Ti 33.7445	Standard	±0.000	....	4481.438			
S 33.7507	4481.499	....	±0.000	4481.400	+0.099	6.6	2
Ti 40.6291	4552.634	−0.002	....	4552.632			
S 40.6590	4552.937	....	−0.002	4552.750	+0.185	12.2	2
Ti 41.6619	Standard	±0.000	....	4563.939			
S 42.0462	4568.189	....	−0.020	4567.950	+0.219	14.4	1
Ti 42.4064	4572.195	−0.039	....	4572.156			

Curvature Cor. +0.0009 mm.

Weighted mean		+10.3	Mean +10.9
V_a	−18.64		
V_d	− 0.12		
Reduction to Sun		−18.76	
Radial Velocity		− 8.5 km.	

1902, September 3, G. M. T. $15^h\ 10^m$
Hour angle W $2^h\ 0^m$

102 *HERCULIS*—B 402

Star rather weak; comparison strong.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 21.1240	Standard	±0.000	....	4338.084			
Ti 27.0559	4387.056	−0.049	....	4387.007			
S 27.1998	4388.291	....	−0.049	4388.100	+0.142	+ 9.7	1
Ti 28.5484	4399.982	−0.047	....	4399.935			
Ti 29.8296	4411.283	−0.043	....	4411.240			
S 30.2799	4415.300	....	−0.043	4415.076	+0.181	12.3	2
Ti 30.5728	4417.927	−0.043	....	4417.884			
Ti 31.6073	4427.286	−0.020	....	4427.266			
S 32.7566	4437.839	....	−0.007	4437.718	+0.114	7.7	2

102 *HERCULIS*—B 402—*Continued*

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 33.4167	4443.975	+0.001	....	4443.976			
Ti 36.0140	Standard	±0.000	....	4468.663			
S 36.3404	4471.829	....	−0.001	4471.676	+0.152	10.2	3
Ti 37.3224	4481.441	−0.003	....	4481.438			
S 37.3290	4481.506	....	−0.003	4481.400	+0.103	6.9	2
Ti 41.1950	4552.603	+0.029	....	4552.632			
S 41.2215	4552.891	....	+0.029	4552.750	+0.170	11.2	2
Ti 45.2260	4563.905	+0.034	....	4563.939			
S 45.6087	4568.151	....	+0.014	4567.950	+0.215	14.1	3
Ti 45.9693	4572.161	−0.005	....	4572.156			
S 46.2301	4575.079	....	−0.004	4574.900	+0.175	11.5	2
Ti 47.5587	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0008 mm. Weighted mean +10.6 Mean +10.4

V_a	−19.65	
V_d	− 0.16	
Reduction to Sun		−19.81
Radial Velocity		− 9.2 km.

SUMMARY OF MEASURES OF 102 *HERCULIS*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 358	1902, July 23	−11.3	5	......	..
B 385	Aug. 11	−12.0	6	−12.8	6
B 397	Aug. 27	− 8.5	5	......	..
B 402	Sept. 3	− 9.2	8	......	..
	Mean	−10.3		−12.8	

Mean of 4 plates −10.4 km.
Mean of all measures −10.8 km.

19. η *LYRAE*

(R. A.= 19^h 10^m; Dec.= +38° 58′; Mag. 4.5; Class IV*b*)

Four plates of this star have been measured, four by A., and two by F. The spectrum contains but few lines, and these are not very sharply defined, so that accurate measurement is difficult.

η *LYRAE*—A 365

1902, July 31, G. M. T. 20^h 54^m Measured by A.
Hour angle W 4^h 21^m Power 21
Star fair; comparison good.

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
S 27.4920	4388.029	....	±0.000	4388.100	−0.071	−4.9	1
Ti 28.5143	Standard	±0.000	....	4399.935			
Ti 30.7921	4427.273	−0.007	....	4427.266			
S 31.6288	4437.606	....	−0.004	4437.718	−0.116	7.8	2
Ti 32.5642	Standard	±0.000	....	4449.313			
Ti 34.0695	4468.691	−0.028	....	4468.663			
S 34.2915	4471.590	....	−0.022	4471.676	−0.108	7.2	2
S 35.0255	4481.264	....	±0.000	4481.400	−0.136	9.1	3
Ti 35.0386	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm. Weighted mean − 7.8 Mean −7.3

V_a	−2.45	
V_d	−0.24	
Reduction to Sun		− 2.69
Radial Velocity		−10.5 km.

η *LYRAE* — B 409

1902, September 13, G. M. T. $17^h\ 57^m$ — Measured by A.
Hour angle W $4^h\ 20^m$ — Star weak; comparison good. — Power 15

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 22.4473	4387.014	−0.007	....	4387.007			
S 22.5690	4388.060	......	−0.006	4388.100	−0.046	−3.1	2
Ti 23.9362	Standard	±0.000	....	4399.935			
S 25.8703	4417.103	....	+0.001	4417.121	−0.017	−1.2	1
Ti 25.9569	4417.883	+0.001	....	4417.884			
Ti 26.9923	4427.268	−0.002	....	4427.266			
S 28.1365	4437.793	....	−0.004	4437.718	+0.071	+4.8	3
Ti 28.8010	4443.981	−0.005	....	4443.976			
Ti 31.1153	Standard	±0.000	....	4465.975			
S 31.7046	4471.688	....	+0.003	4471.676	+0.015	+1.0	3
Ti 32.6982	4481.429	+0.009	....	4481.438			
S 32.6941	4481.388	....	+0.009	4481.400	−0.003	−0.2	3
Ti 39.5651	Standard	±0.000	....	4552.632			
S 39.5829	4552.826	....	±0.000	4552.750	+0.076	+5.0	1

Curvature Cor. +0.0008 mm. — Weighted mean + 1.1 — Mean +1.1

V_a −11.51
V_d − 0.24

Reduction to Sun −11.75
Radial Velocity −10.6 km.

η *LYRAE* — B 422

1902, October 15, G. M. T. $14^h\ 12^m$ — Measured by A.
Hour angle W $2^h\ 45^m$ — Star fair ; comparison good. — Power 21

Ti 29.6491	Standard	±0.000	....	4338.084			
S 29.9775	4340.698	....	±0.000	4340.634	+0.064	+4.4	1
S 35.7220	4388.258	....	±0.000	4388.100	+0.158	10.8	2
Ti 36.5256	Standard	±0.000	....	4395.201			
Ti 40.1270	4427.253	+0.013	....	4427.266			
S 41.2721	4437.777	....	+0.009	4437.718	+0.068	4.6	1
Ti 41.9376	4443.969	+0.007	....	4443.976			
Ti 44.5326	4468.669	−0.006	....	4468.663			
S 44.8526	4471.778	....	−0.004	4471.676	+0.098	6.6	1
Ti 45.8379	Standard	±0.000	....	4481.438			
S 45.8425	4481.483	....	±0.000	4481.400	+0.083	5.6	3

Curvature Cor. +0.0009 mm. — Weighted mean + 6.7 — Mean +6.4

V_a −14.54
V_d − 0.17

Reduction to Sun −14.71
Radial Velocity − 8.0 km.

η *LYRAE* — B 422

Measured by F.
Power 13

Ti 30.0739	Standard	±0.000	....	4338.084			
S 30.4100	4340.762	....	−0.002	4340.634	+0.126	+ 8.7	½
S 36.1563	4388.376	....	−0.036	4388.100	+0.240	16.4	2
Ti 36.9505	4395.241	−0.040	....	4395.201			
Ti 44.9578	4468.686	−0.023	....	4468.663			
S 45.2926	4471.936	....	−0.017	4471.676	+0.243	16.3	3
Ti 46.2628	Standard	±0.000	....	4481.438			
S 46.2719	4481.528	....	±0.000	4481.400	+0.128	8.6	3
Ti 51.1648	Standard	±0.000	....	4563.939			
S 51.5322	4568.011	....	−0.010	4567.950	+0.051	3.4	1
Ti 54.9059	4572.176	−0.020	....	4572.156			

Curvature Cor. + 0.0013 mm. — Weighted mean +12.1 — Mean +10.7

V_a −14.54
V_d − 0.17

Reduction to Sun −14.71
Radial Velocity − 2.6 km.

η *LYRAE* — B 427

1902, October 16, G. M. T. $15^h 32^m$
Hour angle W $4^h 23^m$

Star weak; comparison good.

Measured by A.
Power 21

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 25.6843	4386.989	+0.018	....	4387.007			
S 25.8232	4388.183	....	+0.016	4388.100	+0.099	+ 6.8	2
Ti 27.1756	Standard	±0.000	....	4399.935			
Ti 30.2336	4427.297	−0.031	....	4427.266			
S 31.3788	4437.837	....	−0.020	4437.718	+0.099	6.7	2
Ti 32.0390	4443.989	−0.013	....	4443.976			
Ti 34.6291	4468.668	−0.005	....	4468.663			
S 35.9322	4481.424	....	±0.000	4481.400	+0.024	1.6	3
Ti 35.9336	Standard	±0.000	....	4481.438			
Ti 42.7896	4552.595	+0.037	....	4552.632			
S 42.8125	4552.845	....	+0.037	4552.750	+0.132	8.7	1
Ti 43.8220	Standard	±0.000	....	4563.939			
S 44.1927	4568.055	....	±0.000	4567.950	+0.105	6.9	2

Curvature Cor. +0.0008 mm. Weighted mean + 5.1 Mean +6.1

V_a −14.57
V_d − 0.24

Reduction to Sun −14.81
Radial Velocity − 9.4 km.

η *LYRAE* — B 427

Measured by F.
Power 13

Ti 30.0406	Standard	±0.000	....	4387.007			
S 30.1635	4388.062	....	±0.000	4388.100	−0.038	− 2.6	1
Ti 34.5896	Standard	±0.000	....	4427.266			
S 35.7360	4437.817	....	−0.003	4437.718	+0.096	+ 6.5	1
Ti 36.9653	4449.320	−0.007	....	4449.313			
Ti 39.2676	4471.412	−0.004	....	4471.408			
S 39.3137	4471.861	....	−0.004	4471.676	+0.181	+12.1	3
Ti 40.2880	Standard	±0.000	....	4481.438			
S 40.2929	4481.187	....	±0.000	4481.400	+0.087	+ 5.8	3

Curvature Cor. +0.0013 mm. Weighted mean + 7.2 Mean +5.5

V_a −14.57
V_d − 0.24

Reduction to Sun −14.81
Radial Velocity − 7.6 km.

SUMMARY OF MEASURES OF η *LYRAE*

Plate	Date	Adams	No. of Lines	Frost	No. of Lines
A 365	1902, July 31	−10.5	4	.....	..
B 409	Sept. 13	−10.6	6	.....	..
B 422	Oct. 15	− 8.0	5	−2.6	5
B 427	Oct. 16	− 9.4	5	−7.6	4

Mean − 9.6 −5.1

Mean of 4 plates −8.7 km.
Mean of all measures −9.1 km.

20. ϵ *DELPHINI*

(R. A.=$20^h 28^m$; Dec.= +10° 58′; Mag. 4.1; Class V*a*)

Four plates of this star have been measured, all of them by A. The spectrum contains very few lines, among them traces of one or two oxygen lines, and all of these are poorly defined.

ε *DELPHINI*—A 349

1902, July 11, G. M. T. $17^h 55^m$
Hour angle E $1^h 11^m$

Star weak; comparison good.

Measured by A.
Power 14

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 20.1815	Standard	±0.000	....	4338.084			
S 20.3642	4340.037	....	±0.000	4340.634	−0.597	−41.3	1
Ti 26.0799	Standard	±0.000	....	4404.433			
S 26.9275	4414.558	....	−0.001	4415.076	−0.519	35.3	1
Ti 31.2436	4468.666	−0.003	....	4468.663			
S 31.4346	4471.164	....	−0.002	4471.676	−0.514	34.5	2
S 32.1652	4480.804	....	±0.000	4481.400	−0.596	39.9	4
Ti 32.2129	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm.

Weighted mean −38.2 Mean −37.7

V_a +10.25
V_d + 0.10

Reduction to Sun +10.35
Radial Velocity −27.8 km.

ε *DELPHINI*—A 353

1902, July 16, G. M. T. $18^h 48^m$
Hour angle W $0^h 5^m$

Star good; comparison good.

Measured by A.
Power 17

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 23.8727	Standard	±0.000	....	4338.084			
S 24.0696	4340.189	....	±0.000	4340.634	−0.445	−30.8	1
Ti 28.9894	4395.209	−0.008	....	4395.201			
Ti 29.3926	Standard	±0.000	....	4399.935			
Ti 34.9402	4468.655	+0.008	....	4468.663			
S 35.1308	4471.146	....	+0.006	4471.676	−0.524	35.1	2
S 35.8739	4480.942	....	±0.000	4481.400	−0.458	30.6	1
Ti 35.9112	Standard	±0.000	....	4481.438			

Curvature Cor. +0.0005 mm.

Weighted mean −32.9 Mean −32.2

V_a + 8.22
V_d − 0.01

Reduction to Sun + 8.21
Radial Velocity −24.7 km.

ε *DELPHINI*—A 359

1902, July 23, G. M. T. $19^h 59^m$
Hour angle W $1^h 39^m$

Star fair; comparison fair.

Measured by A.
Power 13

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
Ti 25.0852	Standard	±0.000	....	4338.084			
S 25.2773	4340.139	....	−0.001	4340.634	−0.496	−34.3	2
S 29.5420	4387.590	....	−0.008	4388.100	−0.518	35.4	1
Ti 30.1979	4395.210	−0.009	....	4395.201			
Ti 32.8751	Standard	±0.000	....	4427.266			
Ti 34.2187	4443.956	+0.020	....	4443.976			
Ti 36.1468	4468.649	+0.014	....	4468.663			
S 36.3447	4471.233	....	+0.013	4471.676	−0.430	28.8	1
S 37.0832	4480.970	....	+0.010	4481.400	−0.420	28.1	2
Ti 37.1176	4481.428	+0.010	....	4481.438			
Ti 38.6030	Standard	±0.000	....	4501.445			

Curvature Cor. +0.0005 mm.

Weighted mean −31.5 Mean −31.6

V_a +5.28
V_d −0.14

Reduction to Sun + 5.14
Radial Velocity −26.4 km.

ϵ *DELPHINI*—A 363

1902, July 31, G. M. T. $16^h\ 45^m$ — Measured by A.
Hour angle E $1^h\ 5^m$ — Power 13

Star slightly weak; comparison good.

Mean of Settings	Wave-Length by Formula	Correction to Comp. Lines	Correction to Star Lines	Normal Wave-Length	Displacement	Velocity	Weight
mm.	t. m.	t. m.	t. m.	t. m.	t. m.	km.	
Ti 22.5790	4386.956	+0.051	....	4387.007			
S 22.6325	4387.574	....	+0.049	4388.100	−0.477	−32.6	1
Ti 23.6921	Standard	±0.000	....	4399.935			
S 25.1003	4416.725	....	−0.018	4417.121	−0.414	28.1	1
Ti 25.1978	4417.903	−0.019	....	4417.884			
Ti 25.9676	4427.277	−0.011	....	4427.266			
S 26.7834	4437.355	....	−0.027	4437.718	−0.390	26.4	1
Ti 27.7398	4449.360	−0.047	....	4449.313			
Ti 29.2448	4468.683	−0.020	....	4468.663			
S 29.4421	4471.257	....	−0.016	4471.676	−0.435	29.2	2
S 30.1842	4481.020	....	±0.000	4481.400	−0.380	25.4	2
Ti 30.2157	Standard	±0.000	....	4481.438			
Ti 37.8308	Standard	±0.000	....	4590.126			

Curvature Cor. +0.0005 mm.

Weighted mean	−2.80	Mean −28.3
V_a	+1.91	
V_d	+0.09	
Reduction to Sun	+ 2.00	
Radial Velocity	−26.0 km.	

SUMMARY OF MEASURES OF ϵ *DELPHINI*

Plate	Date	Adams	No. of Lines
A 349	1902, July 11	−27.8	4
A 353	July 16	−24.7	3
A 359	July 23	−26.4	4
A 363	July 31	−26.0	5

Mean −26.2 km.
Mean of all measures −26.2 km.

SUMMARY OF RADIAL VELOCITIES

The table which follows gives a summary of the results for the stars which we have considered in this paper. As the final velocity of each star the mean of all the measures has been adopted, so that a plate measured by both observers will have twice as much weight as a plate measured by only one. This procedure has seemed preferable to that of assigning unit weight to each plate without regard to the number of measures made of it, but the difference between the values found in the two ways is in general very slight, as a brief inspection of the summaries given at the end of the detailed measurements of each star at once shows. Column six of the table below accordingly gives the total number of measures for the individual stars, while the following column indicates the epoch to which the final velocity belongs. For comparison a list of the proper motions of the stars is appended, the values of which have been very kindly communicated to us by Professor Lewis Boss, in advance of their publication in his "Catalogue of 627 Principal Standard Stars" in the *Astronomical Journal* (Nos. 531, 532, February, 1903). For the three stars not included in his "Catalogue" (67 *Ophiuchi*, 102 *Herculis*, and η *Lyrae*) Professor Boss was good enough to furnish us with values in systematic conformity therewith. The proper motions correspond to Professor Newcomb's value of the precession.

SUMMARY

Mag.	Star	R. A.	Dec.	Radial Velocity	No. of Measures	Epoch	Proper Motion R. A.	Proper Motion Dec.	Proper Motion Great Circle
				km.					
3.0	*γ Pegasi*	0^h 08^m	+14° 38′	+ 5.4	12	1902.06	$0^s.0000$	−0″.013	0″.013
3.7	*ζ Cassiopeiae*	0 31	+53 21	+ 2.9	6	1902.10	+0.0024	−0.007	0.023
3.6	*ε Cassiopeiae*	1 47	+63 11	− 5.9	8	1902.08	+0.0058	−0.017	0.043
3.1	*ζ Persei*	3 48	+31 35	+22.1	7	1901.95	+0.0009	−0.017	0.020
0.3	*β Orionis*	5 10	− 8 19	+20.7	24	1901.95	+0.0001	−0.001	0.002
1.9	*γ Orionis*	5 20	+ 6 15	+18.0	10	1901.98	−0.0004	−0.019	0.020
1.8	*ε Orionis*	5 31	− 1 16	+26.7	7	1902.05	0.0000	−0.002	0.002
1.9	*ζ Orionis*	5 36	− 2 00	+18.3	7	1902.52	+0.0005	−0.007	0.010
2.2	*κ Orionis*	5 43	− 9 42	+17.1	10	1901.88	+0.0001	−0.005	0.005
2.0	*β Canis Majoris*	6 18	−17 54	+32.6	5	1901.84	−0.0004	0.000	0.006
1.5	*ε Canis Majoris*	6 55	−28 50	+27.2	4	1902.61	+0.0004	−0.001	0.005
3.6	*η Leonis*	10 02	+17 15	+ 3.5	5	1902.31	−0.0001	−0.012	0.012
2.8	*γ Corvi*	12 11	−16 59	− 7.0	6	1902.27	−0.0113	+0.011	0.162
3.9	*τ Herculis*	16 17	+46 33	−12.7	6	1902.21	−0.0012	+0.031	0.033
3.3	*ζ Draconis*	17 08	+65 50	−14.4	8	1902.19	−0.0021	+0.020	0.024
3.9	*ι Herculis*	17 37	+46 04	−16.4	6	1901.92	−0.0010	−0.006	0.012
4.0	*67 Ophiuchi*	17 56	+ 2 56	− 3.1	4	1902.47	+0.0003	−0.016	0.017
4.5	*102 Herculis*	18 04	+20 48	−10.8	5	1902.62	+0.0003	−0.011	0.012
4.5	*η Lyrae*	19 10	+38 58	− 9.1	6	1902.74	−0.0002	−0.004	0.005
4.1	*ε Delphini*	20 28	+10 58	−26.2	4	1902.55	+0.0006	−0.026	0.027

The distribution of positive and negative velocities in the table shows clearly the direction of the motion of the Sun in space, although the number of stars is, of course, much too small to warrant the determination of the apex or velocity. Conversely, the position of the apex is not accurately enough known to make it seem desirable to tabulate the radial velocities corrected for the solar motion. It is evident on inspection, however, that the absolute velocities of these stars are very small, and a computation, based upon Newcomb's adopted apex (R. A. = 277°.5; Dec. = +35°) and Campbell's solar velocity (19.9 km.), gives 7.0 km. as the mean of the twenty radial velocities after correction for the solar motion; if the sign be regarded, the mean becomes +4.6 km. The exceedingly small proper motions, for stars as bright as these, are striking (in the mean 0″.023; or, omitting *γ Corvi*, which is exceptional, 0″.015), being much smaller than for solar stars of corresponding brightness, and indicate that the stars of the *Orion* type are as a class very remote. The bright stars of the constellation *Orion* evidently group themselves both as to the direction and magnitude of their motions.

The radial velocities of but four of the stars in the list have been previously published, by Vogel and Scheiner in Vol. VII of the Potsdam Publications. They are as follows:

β Orionis	+16.3 km.	*ε Orionis*	+26.7
γ Orionis	+ 8.9	*ζ Orionis*	+14.8

Except in the case of *γ Orionis* the agreement with the values which we have found above is quite satisfactory in view of the character of the spectra, which are most difficult of measurement.

In the course of our observations the following seven stars with spectra of the *Orion* type have been found to have variable radial velocities, and are reserved for discussion elsewhere:[15]

δ Ceti; ν Eridani; η Orionis; β Cephei; ο Persei; π⁵ Orionis; ζ Tauri.

[15] See *Astrophysical Journal*, Vol. XV (1902), pp. 214, 340; *ibid.*, Vol. XVII (1903), pp. 150–52.

REMARKS ON THE CLASSIFICATION OF THE SPECTRA

Although all of the stars which we have investigated in this paper belong to type I*b* of Vogel's classification, their spectra vary greatly both as regards the number and the character of the lines present, and a few subdivisions are certainly desirable. Miss Maury's classification is excellent in this respect, and has the great advantage of being based upon photographs which show a very wide range of spectrum, including the valuable H and K region. From this point of view any attempt at classification based upon the limited range of spectrum given by a high-dispersion spectrograph must be distinctly inferior. A further disadvantage in discussing the characteristics of the spectra which we have obtained lies in the fact that the quality of plates best adapted to determinations of radial velocity is generally quite different from that which would be most suitable for qualitative examination; and the greater density demanded may effectually conceal some of the fainter lines present in the spectra. On the other hand, the higher dispersion and consequent broadening of the spectral lines undoubtedly enable one to judge much better of the behavior and character of the individual lines than would be possible with low dispersion and a small scale. At most, however, the classification of such a limited number of stars as we deal with here must of necessity be mainly empirical, and any order of arrangement will represent rather the succession of the various spectra as regards complexity and character of the lines than the sequence of development of the stars themselves.

The lines which occur in the spectra of the stars which we have investigated, and upon which any classification must be based, are due to the following elements: hydrogen, helium, magnesium, silicon, oxygen, and nitrogen. In some stars faint metallic lines also appear, and there are a few lines as yet unidentified. The extent of spectrum included in this examination of our plates is from λ4300 to λ4720.

In what are probably the earliest stars of this type in order of development no lines are present with the exception of the hydrogen and stronger helium lines, and these are faint, and extremely broad and diffuse. Most of them contain the line $H\gamma'$ at λ4542, which belongs to the series of hydrogen lines first found by Pickering in the spectrum of ζ *Puppis*, and some of them show the line at λ4686, which Rydberg calls the first line of the hydrogen spectrum. Both of these lines are represented by bright bands in the spectra of stars of the Wolf-Rayet type. In the stars which appear most naturally to come next in order these lines disappear, and the hydrogen and helium lines increase in strength, at the same time becoming narrower and more sharply defined. The earliest of this group of stars show traces of the magnesium line at λ4481, and the silicon lines at λ4553, λ4568 and λ4575. While the magnesium line, however, rapidly increases in strength, becoming in the later stars of the group one of the most prominent lines in the spectrum, the silicon lines remain comparatively unimportant. The spectra of the furthest developed stars of this sort, such as ι *Herculis* and β *Orionis*, are characterized by strong and fairly well defined lines of hydrogen and helium, a strong and narrow line at λ4481, and traces of the silicon lines. Faint metallic lines also appear at this point, the most prominent being at λ4550 and λ4584, and indicate the connection of these stars with those distinguished by metallic lines. These last are represented among the stars investigated by ζ *Tauri*, γ *Corvi*, and η *Leonis*, and show a great decline in intensity for the helium lines accompanying the rise of the metallic lines. The magnesium line λ4481, however, is very weak in the case of ζ *Tauri*, though strong in the other two stars, and this fact, together with the remarkable character of its hydrogen lines, which are of a sharpness and brilliancy not approached in any of the other stars, makes the spectrum of this star one of the most interesting that we have encountered.

Up to this point the order of succession of the spectra seems to be fairly clear, but those containing oxygen and nitrogen lines are much harder to classify. This difficulty arises from the fact that in other respects they seem to be almost identical with those which we have just considered. There is the same rise in intensity and increase in sharpness on the part of the hydrogen and helium lines, and the magnesium line appears and develops in almost exactly the same way, reaching nearly,

though never quite, the intensity which it has in such stars as *β Orionis*. On the other hand, we find in the earliest stars of this group the beginnings of a whole series of oxygen and nitrogen lines which develop simultaneously with the hydrogen, helium, and magnesium lines, and attain in the later stars of the group, such as *β Canis Majoris* and *γ Pegasi*, a high degree of prominence. The fact that the three silicon lines, which in the stars considered before never became at all marked features of the spectrum, now follow the behavior of the oxygen and nitrogen lines and gain in intensity with them, is of interest as showing that the stellar conditions seem to be favorable to the simultaneous development of the spectra of the three elements. An examination of these characteristics of the spectrum appears to make the relationship of this group of stars to that which we have considered before one of parallelism rather than succession. For while the order of succession of the individual stars within the two groups is so well defined as to preclude the insertion of either within the other, an attempt to make one follow or precede the other would be equally difficult, without the assumption of the absence of more connecting links than would be justified. Accordingly, it has seemed best to assume a point of division immediately after the earliest stars of the list, and to arrange the stars exhibiting no oxygen or nitrogen lines in their spectra along one branch, while the stars which are characterized by such lines proceed along the other.

In the following table the twenty stars discussed in this paper, together with some others of this type of which we have one or more plates, are collected and arranged. Those whose spectra are very closely allied are connected with brackets, and within the brackets the individual stars are placed in the order of increasing intensities of the lines mentioned.

κ Draconis *ι Orionis* S *Monocerotis* *λ Orionis*	Only hydrogen and stronger helium lines present with Hγ and λ4686. All lines extremely broad and diffuse. Possibly a trace of λ4481 in *λ Orionis*.

π⁵ Orionis *ε Delphini* *ε Cassiopeiae* *η Lyrae* *ζ Draconis* *τ Herculis* *ι Herculis* *β Orionis*	All lines growing narrower and sharper, with λ4481 and helium lines stronger. Traces of silicon lines. No oxygen or nitrogen lines.	*ζ Orionis* *ε Orionis* *κ Orionis*	Lines stronger than above but very diffuse. Traces of λ4481 and silicon lines. Traces of a few oxygen and nitrogen lines with strong λ4649.
ζ Tauri *γ Corvi* *η Leonis*	Helium lines much weaker. Metallic lines grow stronger.	67 *Ophiuchi* 102 *Herculis* *π⁴ Orionis* *χ² Orionis* *γ Orionis* *ζ Persei* *η Orionis* *β Cephei* *ζ Cassiopeiae* *ε Canis Majoris* *β Canis Majoris* *δ Ceti* *γ Pegasi*	All lines growing narrower and sharper, with λ4481, helium, and silicon lines stronger. Oxygen and nitrogen lines increase in number and grow sharper and stronger.

DESCRIPTION OF THE PLATES

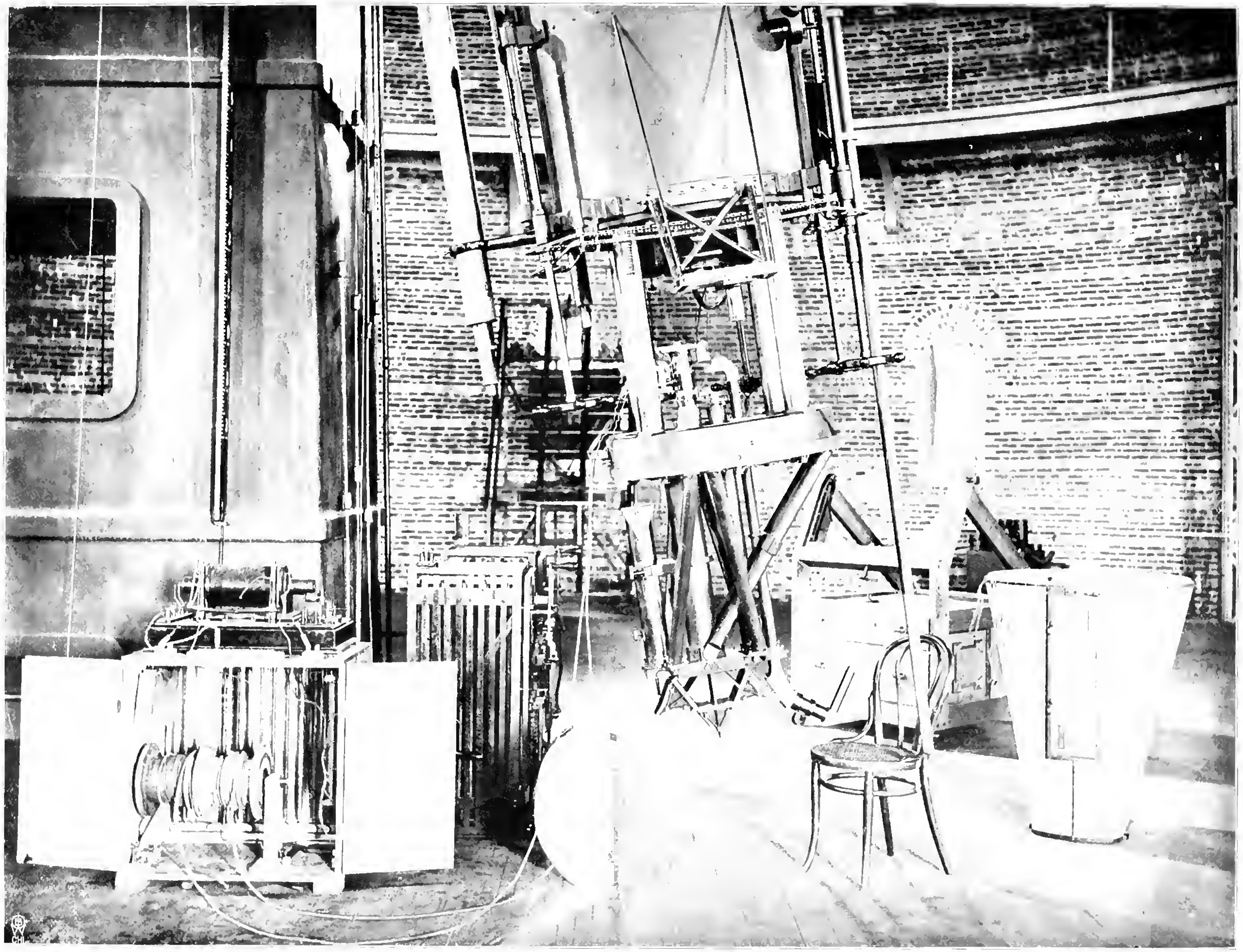
Plate I shows the spectrograph attached to the forty-inch telescope. The cells containing each of the three prisms may be readily seen, rigidly attached to the main casting, in their invariable position. The twenty-four-inch camera tube for camera lens B is seen in place. The chair is set in the proper position for an observer to conveniently look (down) into the guiding telescope. The tube extending from the guiding telescope below to the "goose-neck" above conveys the rays which have been reflected from the polished slit-jaws, and then caught and deflected downward by diagonal prisms within the "goose-neck." To the left of this may be seen the apparatus for producing the comparison spectrum, and the slit, although the scale of the illustration does not permit the details to be clearly apparent. The long rod which would be at the left hand of an observer sitting in the chair is used to assist in guiding, and the whole telescope may be slightly sprung to follow the star. The switches controlling the electric slow-motions in right ascension and declination, which are always within easy reach of the observer, could not be shown when the temperature case was removed, as here. The light inner aluminium case, or prism-box, is seen on the floor at the left below the prisms. The double-walled outer temperature case, which incloses the whole spectrograph, except the slit, is at the extreme right. Behind it is the carriage upon which the spectrograph rests when not attached to the telescope. The induction coil is seen at the left. The box beneath it contains the condenser (at left), the self-induction coil (at right), and the drum upon which is wound the cable conveying the secondary current to the spectrograph.

Plate II shows the comparator made by Gaertner & Co., which is sufficiently described on p. 6.

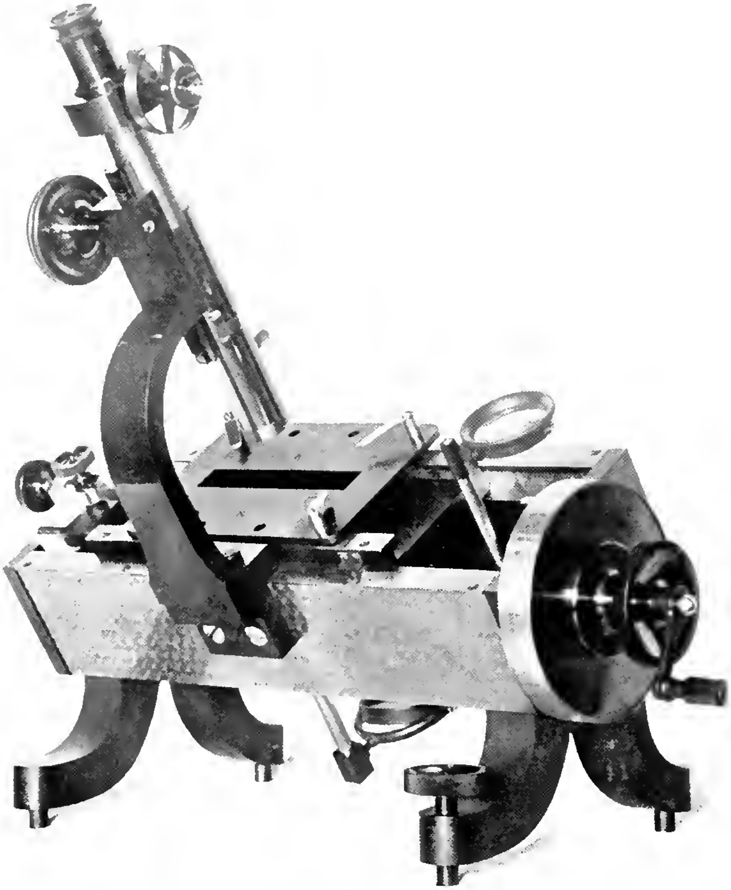
Several examples of spectra described in this paper are given in Plate III. The negatives used were α *Boötis*, B 300; β *Orionis*, B 282; β *Canis Majoris*, B 215; ϵ *Canis Majoris*, B 461; and η *Leonis*, B 329.

A recent important modification of the pendulum apparatus for vertical enlargement of spectra has permitted the comparison spectrum to receive the same treatment as the stellar spectrum. The positives from which the half-tone blocks were made were prepared by Mr. Ellerman. As shown here the enlargement over the original negatives is vertically almost forty-fold, and horizontally only four-fold (3.8). Any process of vertical enlargement necessarily introduces false lines in the stellar spectra, which may be confusing in spectra having few lines, although inconspicuous in the spectra of the solar type. We have accordingly indicated the chemical origin of all of the more important lines on the three spectra having the fewest lines.

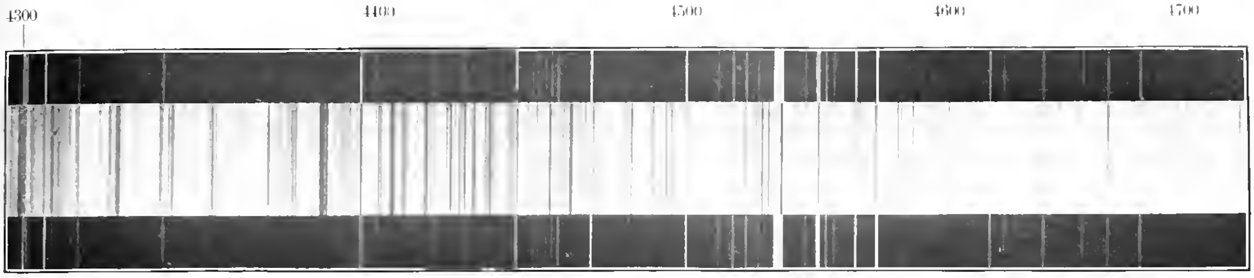
The plates have not been retouched by photographer or engraver, but the intensity of the continuous spectrum was rendered as uniform as possible by shading the brightest parts during the process of enlargement.



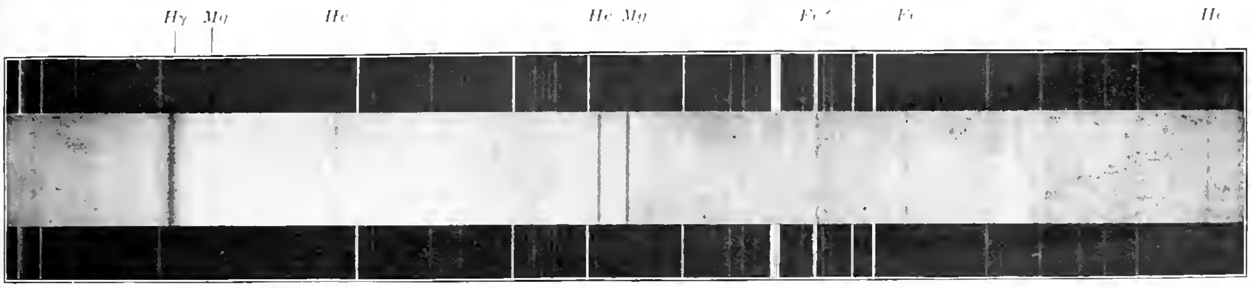
THE BRUCE SPECTROGRAPH WITH ITS ACCESSORIES



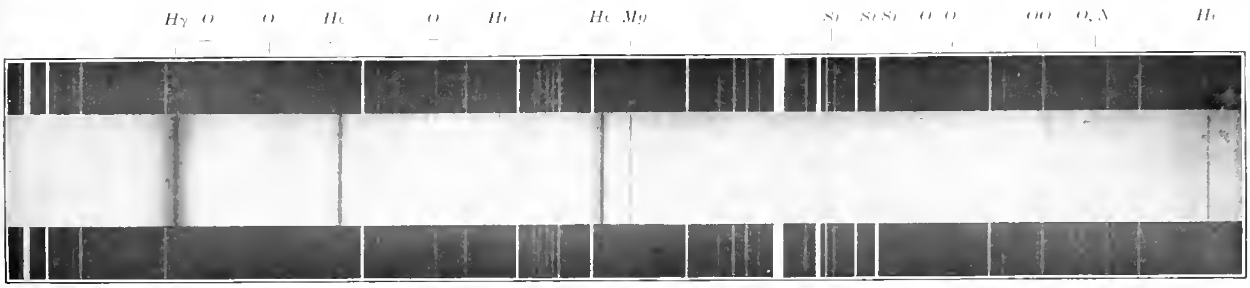
MEASURING MACHINE FOR STELLAR SPECTRA



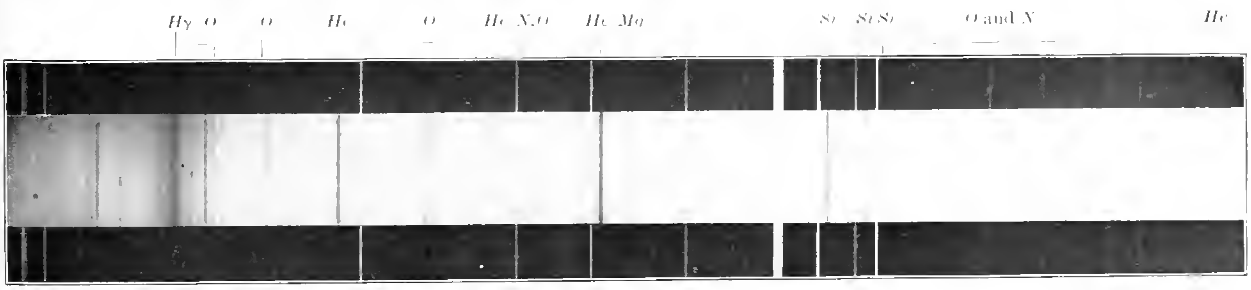
α BOÖTIS



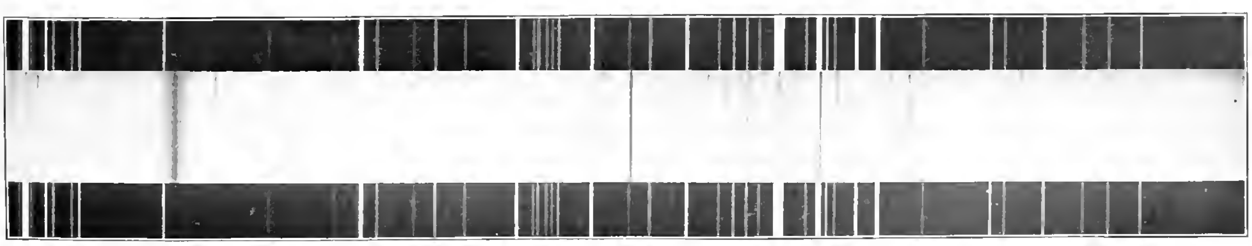
β ORIONIS



β CANIS MAJORIS



ε CANIS MAJORIS



η LEONIS

EXAMPLES OF STELLAR SPECTRA
With Comparison Spectrum of Titanium

THE SPECTRA OF STARS OF SECCHI'S FOURTH TYPE

THE SPECTRA OF STARS OF SECCHI'S FOURTH TYPE

George E. Hale, Ferdinand Ellerman, and J. A. Parkhurst

The possibility of basing a systematic scheme of stellar evolution on spectroscopic observations is foreshadowed in the work of Fraunhofer, who in 1823 observed for the first time the spectra of a few of the brightest stars. Though wholly ignorant of the origin of the dark lines in these spectra, Fraunhofer recognized that their number, appearance, and grouping differed greatly from star to star, and that in certain cases the solar spectrum seemed to be exactly duplicated. But it required such a general survey as that of Secchi, who examined the spectra of more than four thousand stars, to afford any basis for a scheme of classification. The purely empirical classification which he adopted includes a very large percentage of the stars among its five principal types, and subsequent systems have done little more than to add subgroups to provide for the comparatively few peculiar spectra which do not fall within Secchi's divisions.

Secchi's classification, as we have said, was a purely empirical one, intended to serve only as a convenient means of grouping similar spectra. But the researches of Huggins and Vogel soon introduced the idea of development, and the changes of spectra from type to type came to be regarded as synonymous with progressive changes in the stars themselves. Spectroscopists have agreed in regarding the white stars, with spectra characterized by the predominance of the series of hydrogen lines (Secchi's first type), as representing an early stage of development, corresponding to a condition of low density. Through the continued action of gravity, accompanied by loss of heat, the absorbing metallic vapors increase in density, producing a marked increase in the number and strength of the metallic lines, while the hydrogen lines become narrower and less conspicuous (Secchi's second type). The reduction of light caused by the greater absorption is most marked at the violet end of the spectrum, causing the color of the star to change from white to yellow. After passing this, the solar, stage, further operation of the same causes results in the production of red stars, whose spectra might be expected to indicate comparatively low temperature and high density of the absorbing vapors.

It is not clear, however, why there should be two distinct classes of red stars, characterized by widely different banded spectra. One of these classes (Secchi's third type), which includes such bright stars as *a Orionis*, *a Scorpii*, and *a Herculis*, is comparatively well known. In the pioneer days of stellar spectroscopy Huggins and Vogel measured some seventy lines in the spectrum of *a Orionis*, and the more refrangible region of the spectra of some of these stars has more recently been studied photographically by these and other observers. But much remains to be done by photographic means, particularly in the less refrangible region, where Keeler was working with marked success when interrupted by his untimely death. In the present paper our photographs of the spectra of some of these stars are reproduced for comparison with the spectra of stars of Secchi's fourth type, but the measurement of these photographs has not yet been undertaken.

As the other great class of red stars (Secchi's fourth type) includes no objects brighter than magnitude 5.3, it is obvious that the detailed investigation of their spectra is beyond the reach of telescopes of small aperture. It will be seen from the references given below that the general characteristics of these spectra were clearly recognized in the visual observations of Secchi, Dunér, Vogel, and others, but it was impossible with the instruments employed by them to observe more than the carbon bands and two or three prominent lines. Even the objective prism, as applied in conjunction with photography, has failed to show the less conspicuous details, though it has been invaluable in discovering new objects and in showing the relative intensities of the various bands in different stars. As the great light-gathering power of the forty-inch Yerkes refractor seemed to render it especially suitable for an investigation of these faint stars, the work described in this paper was undertaken in

January, 1898. In conjunction with this investigation photographs have been made of the spectra of a number of stars of other types, researches on the condition of carbon in the solar chromosphere and on the widened lines in Sun-spots have been set on foot, and considerable work on the spectrum of carbon and other substances has been done in the laboratory.

REVIEW OF PREVIOUS OBSERVATIONS

In his first classification of stellar spectra Secchi made no distinction between the two types of red stars. Indeed, a star later recognized by him as of the fourth type (*Lalande* 12,561) was classed in the memoir *Sugli spettri prismatici delle stelle fisse* (*Memoria Prima*, 1867) with *α Herculis* in the following words (*Catalogo*, p. 14): "In conclusione è tipo di *α* Ercole, ma con zone nere mancanti, onde le sue sono large tanto, che alcune ne abbracciano due di quelle di *α* Ercole." After giving measurements to show the agreement in the position of the bands with those of *α Herculis*, Secchi adds, however: "Le zone sono notabili per avere il verso della luce in senso opposto dell' ordinario."

In the second memoir (*Memoria Seconda*, 1868) it appears that the distinctive characteristics of fourth-type spectra were recognized in the course of a survey of some twenty red stars from Schjellerup's catalogue. In describing the spectrum of 152 *Schjellerup* as characteristic of the class, Secchi remarks (p. 9):

> Questo tipo è dunque composto di tre sole zone principali; una viva nel verde, una debole nel bleu e una assai viva nel rosso. Quest' ultima è spesso subdivisa in altre zone minori.
>
> Questo tipo differisce essenzialmente dal 3° non solo per la divisione della zone, le quali hanno una larghezza doppia, ma anche perchè le zone hanno la maggiore intensità luminosa in verso opposto. Cioè esse nel 4° tipo vanno crescendo di luce dal rosso verso il violetto, mentre quelle del terzo sono disposte al contrario. Talchè rappresentando il 3° tipo come un sistema di colonne, il quarto sarebbe rappresentato da cavità, supponendo la luce illuminante diretta nello stesso verso.

Few objects having spectra of the fourth type were known to Secchi, but many were discovered in the subsequent observations of Vogel, D'Arrest, Dunér, Pickering, and Espin. Pickering's first discoveries were made visually, but a very large percentage of the fourth-type stars discovered at the Harvard Observatory have been found on photographs taken with an objective prism. Qualitative observations of various fourth-type spectra, made with a small direct-vision spectroscope, are given by Friedrich Krueger in his "Catalog der farbigen Sterne."[1] McClean photographed the spectrum of 152 *Schjellerup* with an objective prism in 1896. He describes his results as follows:[2]

> Two different photographs are given of the star 152 *Schjellerup* of the 5½ magnitude. Two hours' exposure was required, which accounts for the exaggerated distortion due to the changing amount of refraction during exposure. The value of the faint details is enhanced by the correspondence of the two photographs. The presence of a line-absorption spectrum is distinctly shown, and it appears to agree to a marked extent with the usual line spectrum of Types II and III. There appears to be no trace of Dunér's Band No. 5 of Type III. The inference seems to be that spectra of Type IV arise from a natural course of change in these stars, passing directly from Type II. They are stars of Type II become less luminous, but not different in kind.

McClean also reproduces objective-prism photographs of the spectra of 19 *Piscium* and 152 *Schjellerup* in an article in the *Philosophical Transactions*, Vol. CXCI, A, p. 131, Plate XIV. His photograph of 19 *Piscium* shows only the bands, but in the two spectra of 152 *Schjellerup* some of the more conspicuous dark lines are visible. These photographs were the first to show any of the lines; unfortunately they do not seem to have been measured. A large number of fourth-type spectra have been photographed with the objective prism at the Harvard Observatory, but while the bands are well shown, the lines do not appear in these photographs. A complete list of all fourth-type stars known at that time was published in 1898 by Espin,[3] who has himself discovered many objects of this character. The classic memoir published by Dunér in 1884, "Sur les étoiles à spectres de la troisième classe,"[4]

[1] *Publicationen der Sternwarte in Kiel*, Band VIII, Kiel, 1893.

[2] *Monthly Notices*, Vol. LVII, p. 8.

[3] *Ibid.*, Vol. LVIII, p. 443.

[4] *Svenska Vetenskaps-Akademiens Handlingar*, Vol. XXI, No. 2.

Vogel's observations with the twenty-seven-inch refractor of the Vienna Observatory,[5] and McClean's photographs of 152 *Schjellerup* have afforded the best available data for the study of the spectra.

Dunér's important observations, which are frequently to be referred to in this paper, were made with several direct-vision spectroscopes of different dispersive powers attached to the ten-inch refractor of the Lund Observatory. In spite of the insufficiency of his instrumental equipment, which prevented him from seeing the dark and bright lines in the spectra of fourth-type stars, Dunér's results are of the highest value, and his conclusions are confirmed in almost every particular by our photographs. In a recent paper[6] Dunér has described his observations of bright lines in fourth-type spectra, made at the Upsala Observatory with a telescope of 36 cm. aperture. Further reference to these observations will be made below. Dunér's drawings of fourth-type spectra are reproduced from his first memoir in Plate V. His general description of fourth-type (III*b*) spectra is as follows:

> Les spectres des étoiles de la classe III*b* consistent, s'ils sont parfaitement développés, en quatre zones brillantes, séparées par des bandes obscures, dégradées vers le violet, et d'une largeur extraordinaire, au moins le double de celles de la classe III*a*. La zone rouge-jaune est subdivisée par des bandes plus faibles et moins larges, dégradées soit vers le rouge, soit vers les deux côtés. La sous-zone jaune (longueur d'onde 563–589) est ordinairement la partie la plus brillante du spectre entier, et elle, ainsi que la sous-zone rouge voisine (longueur d'onde 589–621), est divisée en deux par une bande bien marquée, mais si étroite qu'elle ressemble, dans des spectroscopes d'une faible dispersion, à une raie ordinaire. En outre il y a, dans la zone verte, deux raies, ou peut-être deux bandes très étroites.
>
> Ces caractères sont, j'en suis sûr, non moins constants, dans les spectres de cette classe, que le sont pour la classe III*a* ceux donnés ci dessus, et on les reconnaîtra indubitablement chez toutes les étoiles qui y appartiennent, à mesure qu'on pourra les examiner avec des lunettes suffisamment fortes, et à mesure que les étoiles se trouveront dans une phase de dévéloppement suffisamment avancée. Dans une lunette de 245 millimètres d'objectif comme la nôtre, il y a cependant des détails dans les spectres de la plupart de ces étoiles, qu'on ne peut apercevoir. D'abord les bandes secondaires, et les raies dans la zone verte sont plus ou moins invisibles dans les spectres des étoiles faibles, et même dans les étoiles les plus brillantes ($5^m.5$ seulement!) leur intensité peut être très différente. Puis l'intensité de la lumière des zones brillantes peut varier considérablement chez des étoiles de la même grandeur. Dans les étoiles d'un rouge foncé, la zone ultra-bleue est extrêmement faible en comparaison avec la même zone dans les étoiles rouge-jaune; et chez les étoiles faibles, cette zone est tout-à-fait invisible, et même la zone bleue est très difficile à voir si elles sont très rouges.
>
> Mais aussi la bande principale à la longueur d'onde 563 est d'une opacité très variée. Chez certaines étoiles, elle est presque aussi foncée que les deux autres bandes principales; mais dans certains spectres elle est assez faible, et semble, probablement à cause de cela, être beaucoup moins large que les bandes aux longueurs d'onde 516 et 473. Celles-ci, et surtout la première d'entre elles, sont toujours très fortes et très larges, et forment le caractère le plus prononcé de ces spectres. Toutes les étoiles de cette classe sont très fortement colorées, au moins d'un rouge-jaune fort mais quelques-unes d'entre elles sont presque rouges.[7]

Dunér's measures of fourth-type (III*b*) spectra, as tabulated on p. 122 of his memoir, are given below, reduced to Rowland's scale:

WAVE-LENGTHS DETERMINED BY DUNÉR

OBJECT	19 *Piscium*	132 *Schj.*	152 *Schj.*	132 *Schj.*	152 *Schj.*	WAVE-LENGTH
Band 2	621	....	....	....	....	621
Band 3	6049	....	....	....	....	6049
Band 4 (maximum)	5896	5885	....	5896	5911	5899
Band 5	5761	5758	5748	5763	5762	5761
Band 6 (beginning)	....	5641	5625	5634	5635	5634
Band 7	551	....	....	....	....	551
Band 6 (end)	....	....	....	....	545	545
Band 8	5286	....	....	....	5281	5284
Band 9 (beginning)	....	5168	5160	5161	5165	5164
Band 9 (end)	....	....	....	....	496	496
Band 10 (beginning)	....	4715	4721	4730	4740	4728
Band 10 (end)	463	....	....	....	....	463
End of spectrum	....	....	437	....	....	437

[5] *Publicationen der Astrophysikalisches Observatorium zu Potsdam*, Vol. IV, Part I.

[6] "On the Spectra of Stars of Class III*b*," *Astrophysical Journal*, Vol. IX (1899), p. 119.

[7] *Loc. cit.*, pp. 9, 10.

In his observations at Bothkamp, and in his later work with the twenty-seven-inch Vienna refractor, Vogel measured the spectra of the stars Nos. 51, 78, 152, and 273 of Schjellerup's catalogue, and also that of *DM.* +34° 4500. Vogel's drawings of the spectra of 152 *Schjellerup* and *DM.* +34° 4500 are reproduced in Plate V. His measures (reduced to Rowland's scale) are given in the following table, which is taken from Vol. IV of the *Potsdam Publications:*

WAVE-LENGTHS DETERMINED BY VOGEL

OBJECT	152 *Schj.* (Vienna)	152 *Schj.* (Vienna)	152 *Schj.* (Bothkamp)	*DM.* +34 4500 (Vienna)	273 *Schj.* (Bothkamp)	78 *Schj.* (Bothkamp)	51 *Schj.* (Bothkamp)	MEAN
Beginning of spectrum	....	....	660	....	....	....	....	660
Dark band	....	....	....	....	656	....	....	656
Dark band	....	....	622	....	622	623	....	622
Dark band	....	....	....	....	6066	...	....	6066
Line in a band	5892	....	5893	5890	589	590	....	5894
End of band	5849	....	....	....	....	....	....	5849
Line	5742	....	5759	5751	578	5756	....	5758
Line beginning a band	5622	5626	5629	5621	564	564	5641	5632
Line	....	....	552	....	552	....	....	552
Line	....	....	544	....	....	....	....	544
Group of lines	....	....	528	527	529	....	....	528
Line beginning a band	5160	5164	5157	5162	516	515	5166	5160
Line	5133	....	....	....	....	....	....	5133
Beginning of band	4717	....	4736	4745	472	473	....	4730
Band	....	....	437	....	....	....	....	437
End of spectrum	....	....	430	....	....	....	....	430

The combined results of the two observers, compared with Kayser and Runge's wave-lengths of the "hydrocarbon" bands, are contained in the following table:[8]

COMPARISON OF WAVE-LENGTHS

OBJECT	VOGEL	DUNÉR	MEAN	SWAN SPECTRUM
Spectrum begins	660	....	660	
Dark band	656	....	656	
Dark band	622	621	6215	
Dark band	6066	6049	6058	6060 Middle of red band
Line in a band	5894	5899	5897	
End of a band	5849	....	5849	
Line	5758	5761	5760	
Line beginning a band	5632	5631	5633	5635.43 Beginning of yellow band
Line	552	551	5515	
Line	544	545	5445	
System of lines	528	5281	5282	
Line beginning a band	5160	5164	5162	5165.30 Beginning of green band
....	....	496	496	
Line	5133	....	5133	
Beginning of a band	4730	4728	4729	4737.18 Beginning of blue band
....	....	463	463	
Band	437	437	437	4381.93 Beginning of fifth band
End of spectrum	430	....	430	

In discussing these results Scheiner, basing his conclusion on the supposition that the hydrocarbons are all reduced to acetylene (C_2H_2) at high temperatures and are characterized by a common spectrum which perhaps belongs to this substance, remarks: "We may, therefore, go a step farther and consider that in the stars of Class III*b* carbon and hydrogen are united in the form of acetylene, which is the first combination of these two elements which would ensue as the temperature fell." It will be shown later in this paper that this conclusion must in all probability be modified on account of recent advances in our knowledge of the spectra of carbon compounds.

Of the 242 stars of the fourth type catalogued by Espin there are but three in the northern hemisphere and four in the southern that are brighter than the sixth magnitude. Of the stars which

[8] FROST-SCHEINER, *Astronomical Spectroscopy*, p. 314.

have been observed photometrically Espin finds twenty-three between magnitude 6.1 and 7; thirty-nine between 7.1 and 8; seventy-six between 8.1 and 9; and eighty below 9. The red color of the stars is largely due to the extreme faintness of the blue and violet rays, and this fact greatly increases the difficulty of photographing the more refrangible region of their spectra.

INSTRUMENTS USED IN THIS RESEARCH

Most of the photographs used in the present investigation were taken with a three-prism spectrograph attached to the forty-inch refractor of the Yerkes Observatory. The form of the color-curve of the forty-inch objective has an important bearing on the relative brightness of different regions of the photographed spectra. In work on the yellow and green regions of the spectrum the slit of the spectrograph has ordinarily been set at the focus corresponding to λ 5000. The spectra of fourth-type stars generally increase in brightness from the head of the yellow carbon band toward a maximum in the green. On account of the loss of light due to the rise in the color curve and the fall in the curve of sensitiveness of ordinary isochromatic plates in the neighborhood of the *b* group, the intensity of the photographs of spectra is more nearly uniform in the green than it should be. For a similar reason the less refrangible half of the bright zone in the yellow is too faint on our photographs. These facts should be borne in mind when examining the plates which accompany this paper; it must also be remembered that the relative intensities of different regions are affected by the shading of the photographs during enlargement, which is necessary in order to bring out the lines properly. In the blue part of the spectrum, on account of the steepness of the color curve, a correcting lens near the focal plane is required. The lens not only increases the extent of spectrum photographed on a single plate, but also facilitates guiding, and thus materially reduces the exposure time.

As the spectrograph has been fully described elsewhere,[9] a very few details will suffice here. It consists essentially of a Huggins reflecting slit, with guiding eyepiece, a collimator of 31 mm. aperture and focal length of 507 mm., three 60° prisms of heavy flint glass ($n = 1.6960$), and several cameras of different focal lengths. The camera objective ordinarily employed is a photographic doublet of 37 mm. aperture and 271 mm. focal length. This gives the best results when used with a collimator objective corrected for the visual rays. For the faintest stars a camera with photographic doublet of 40 mm. aperture and about 150 mm. focal length was employed. In the earlier work one prism was frequently used with a camera of 508 mm. focal length, but it was soon found that much more satisfactory results could be obtained with three prisms and a short camera. The prisms are of a distinctly yellowish color, and undoubtedly exercise considerable absorption in the blue and violet. A spark between iron or titanium poles was used for the comparison spectrum. Unfortunately the spectrograph was not provided with a constant temperature case (Plate IV).

For the brighter stars, when it is not desired to photograph a considerable range of spectrum, slit-widths ranging from 0.01 mm. to 0.04 mm. may be used to advantage, even with an instrument having the great focal length of the forty-inch telescope. In the investigations of Messrs. Frost and Adams on stellar motions in the line of sight such widths are actually employed. But in our work on the faint red stars it was found necessary to use slit-widths as great as 0.1 mm. As the camera lens commonly preferred has a focal length whose ratio to the focal length of the collimator objective is 1: 1.9, it is evident that the breadth of the spectrum and also the width of the lines are reduced in this ratio. With a slit-width of 0.15 mm. and a dispersion of three 60° prisms, the yellow and green regions of the spectrum of 280 *Schjellerup* (mag. 7.8) required an exposure of nine hours.[10]

As recent work with the forty-inch telescope has shown that the original spectrograph is inferior in many respects to the new Bruce spectrograph, it is important that the weak points of the older

[9] GEORGE E. HALE AND FERDINAND ELLERMAN, "On the Spectra of Stars of Secchi's Fourth Type," *Astrophysical Journal*, Vol. X (1899), p. 93.

[10] This photograph has been reproduced in *Yerkes Observatory Bulletin* No. 7. With the same optical combination, and with a slit-width of 0.075 mm., the green bands in the spectrum of *a Orionis* were photographed in twenty seconds.

instrument should be pointed out, on account of their bearing on the results obtained in the present investigation. The old spectrograph was constructed by Brashear in 1893. In all respects it was almost an exact duplicate of the spectrograph designed two years previously by Keeler for the Allegheny Observatory. In most particulars it was a distinct advance upon previous instruments, especially in its embodiment of Keeler's train of three prisms, giving a deviation of about 180°, which has been adopted in almost every spectrograph constructed since that time for the determination of stellar velocities in the line of sight. It inherited from earlier instruments, however, certain defects of construction which might give no trouble in visual observations, but have made themselves felt in the long exposures required in the present investigation. The three prisms of the train, instead of being firmly clamped in a fixed position, in accordance with the practice familiar in recent instruments, were mounted on an automatic minimum deviation device. When set for any particular part of the spectrum the prisms and camera were clamped in place. It might be supposed that such clamping would eliminate all difficulties arising from the instability of the prism supports, but experience has not shown this to be the case. As at first constructed the brass plate upon which the prisms rested was very light. This was replaced by a strong ribbed plate of much heavier brass, made after Professor Wadsworth's design in our instrument shop, which undoubtedly improved the spectrograph. The prism supports were also changed for the better, and various other modifications effected in the spectrograph at this time certainly tended to increase its efficiency. It was subsequently found, however, as has been fully explained elsewhere by Professor Frost,[11] that, even when all customary precautions had been taken in his use of the instrument, the velocities of stars in the line of sight determined with its aid were sometimes subject to marked uncertainty, though some of the results were excellent. There can be no doubt, therefore, that results much more satisfactory than those here presented could have been obtained if an instrument as stable as the Bruce spectrograph had been available for the present work.

It will be seen that the circumstances were not at all favorable for the accurate measurement of radial velocities, and when the work was undertaken it was not proposed to attempt such determinations. Nevertheless, precautions were taken to avoid systematic errors, and the approximate velocities of a few of the fourth-type stars have been measured. The measurement of the plates made with the old instrument has been greatly facilitated by the use of three excellent negatives obtained with the Bruce spectrograph. Had the old spectrograph been built in such a way as to eliminate all possible effects of flexure, and provided with a constant-temperature case, good determinations of velocity could undoubtedly have been obtained for stars as faint as the eighth magnitude. The experience gained in the use of this instrument has been embodied in the Bruce spectrograph, which seems to possess none of the faults of its predecessor. At present the old spectrograph is employed with the two-foot reflector.[12] On account of the absence of chromatic aberration in the reflector, it was found possible to obtain a photograph of the spectrum of 19 *Piscium*, extending beyond the H and K lines, with an exposure (on three nights) of twenty-four and one-half hours (Plate X).

While the precision attained in the present research is greatly inferior to that of recent investigations of stellar motions in the line of sight, it is nevertheless sufficient for many purposes. As will be shown below, photographs of the spectra of a large number of fourth-type stars with moderate dispersion, and of a few selected stars with the highest feasible dispersion, are still greatly to be desired.

JOURNAL OF OBSERVATIONS

Most of the photographs were taken in the yellow-green (Y. G.) or in the blue region of the spectrum, but a few in the yellow-red (Y. R.) were secured with the aid of Erythro plates. In the earlier work, and for special purposes later, a single dense flint (D. F.) prism was employed, but the train of three dense flint prisms was generally preferred. A few photographs — including those made

[11] "The Bruce Spectrograph of the Yerkes Observatory," *Astrophysical Journal*, Vol. XV (1902), p. 12.

[12] G. W. RITCHEY, "The Two-Foot Reflecting Telescope of the Yerkes Observatory," *Astrophysical Journal*, Vol. XIV (1901), p. 217.

with the two-foot reflector — were taken with a single light flint (L. F.) prism, and in one case a 30° prism, silvered on the back surface, was used with the solar spectrograph. The focal lengths of the various cameras are as follows: No. 0 = 151 mm., No. 1 = 271 mm., No. 2 = 508 mm., A (Bruce spectrograph) = 449 mm.

The photographic plates which proved most satisfactory were Erythro for the yellow-red, Cramer Instantaneous Isochromatic (C. I. I.) for the yellow-green, and Cramer Crown for the blue.

Star	No.	Date	Disp.	Camera	Plate	Region	H. A. Mid.	Slit	Hour Beg.	Exp.	Comp. Spectrum Beg.	Comp. Spectrum End	Comp. Spectrum Kind	Temp. Beg.	Temp. End	Seeing	Remarks
		1898							h m	m	s	s		F.	F.		
132 *Schj.*	147	Jan. 28	1 D. F.	2	C. I. I.	Y. G.	....	4.0	14 15	120	3	3	*Fe* Spark	18.0	12.5	poor	
152 "	148	" 28	"	2	"	"	....	4.0	16 45	105	3	3	"	12.0	11.5	fair	
74 "	151	" 31	"	2	"	"	....	4.0	10 05	120	....	....	Moon	6.5	3.0	poor	
74 "	155	Feb. 2	"	2	"	"	....	3.0	10 58	114	....	90	"	− 4.0	− 7.5	......	
51 "	156	" 3	"	2	"	"	....	3.0	6 46	165	....	7	*Fe* Spark	13.5	13.8	......	
78 "	159	" 5	"	2	"	"	....	3.0	9 03	280	....	8	"	18.7	16.8	good	
318 *Birm.*	160	" 6	"	2	"	"	....	3.0	9 42	253	4	....	"	27.0	26.5	fair	
229 *Schj.*	161	" 6	"	2	"	"	....	4.0	15 33	175	....	7	"	27.5	28.0	"	
155 b "	164	" 13	"	2	"	"	....	5.0	15 32	85	....	$2\frac{1}{2}$	"	25.0	......	"	
7 "	165	" 15	"	2	"	"	....	3.0	7 20	?	2	....	"	19.7	......	poor	
155 b "	167	" 15	"	2	"	"	....	3.0	14 43	188	2	2	"	17.6	15.0	fair	
27 a "	169	" 24	"	2	"	"	....	4.0	7 00	360	....	2	"	13.6	7.0	poor	
229 "	170	" 24	"	2	"	"	....	3.0	14 25	210	....	2	"	6.5	7.0	"	
72 "	171	" 25	"	2	"	"	....	4.0	7 00	330	....	2	"	18.5	12.0	"	
41 "	175	March 3	"	2	"	"	....	3.0	7 05	420	....	3	"	28.0	18.0	fair	
132 "	177	" 16	3 D. F.	2	"	"	....	3.0	7 23	190	10	10	"	47.8	42.4	poor	
152 "	178	" 16	"	2	"	"	....	3.0	13 22	248	10	10	"	38.8	33.3	fair	
152 "	179	" 17	"	2	"	"	....	3.0	7 36	264	10	10	"	40.0	......	"	
152 "	181	" 24	"	2	"	"	....	3.0	7 28	305	13	15	"	39.0	33.5	poor	
229 "	182	" 30	1 D. F.	2	"	"	....	3.0	13 15	115	....	7	"	29.3	29.0	"	
132 "	184	April 7	"	2	Crown	Blue	....	4.0	7 00	325	2	2	"	41.5	35.7	fair	
132 "	186	" 13 " 14 " 15	3 D. F. "	2	"	"	....	4	10 20 7 15 7 22	125 346 300	9 15 15	 15	" " "	44.2 52.0 54.0	42.3 44.0 52.0	poor fair good	
249 a "	193	May 13	1 D. F.	1	C. I. I.	Y. G.	....	4.0	13 33	140	....	5	"	46.0	46.5	fair	
541 *Birm.*	194	" 25	"	1	"	"	....	8.0	11 29	243	....	4	"	56.0	52.0	poor	
219 *Schj.*	195	" 26	"	1	"	"	....	7.0	11 48	115	....	....	....	60.0	......	fair	
509 *Birm.*	196	" 29	"	1	"	"	....	7.0	10 25	95	....	4	*Fe* Spark	......	49.0	poor	
458 "	197	" 30	"	1	"	"	....	6.0	10 00	140	....	....	....	56.0	......	"	
238 *Schj.*	198	" 30	"	1	"	"	....	6.0	13 00	153	....	....	....	......	......	"	
152 "	199	June 1	3 D. F.	2	"	"	....	3.0	8 52	392	20	20	*Fe* Spark	68.6	58.0	fair	
152 "	200	" 2	"	2	"	"	....	3.0	8 15	395	20	25	"	66.0	57.5	"	
521 *Birm.*	201	" 3	1 D. F.	1	"	"	....	8.0	8 55	205	....	4	"	72.0	......	"	
280 *Schj.*	202	" 3	"	1	"	"	....	8.0	12 44	250	....	4	"	68.0	......	bad	
251 "	203	" 4	"	1	"	"	....	7.0	10 55	135	....	4	"	72.0	......	good	
152 "	209	" 17	"	2	Erythro	Y. R.	....	7.0	8 47	180	95	90	"	......	......	fair	
152 "	210	" 22	"	2	"	"	....	7.0	11 20	200	120	90	"	......	......	poor	
152 "	211	July 1	"	2	"	"	....	6.0	8 30	350	90	90	"	80.0	......	good	
152 "	213	" 6	"	2	"	"	....	6.0	8 49	300	90	90	"	74.0	......	"	
152 "	214	" 8	"	2	Crown	Blue	....	4.0	8 55	280	4	5	"	71.0	68.0	poor	
249 a "	216	" 13	"	2	C. I. I.	Y. G.	....	5.0	11 10	195	5	5	"	69.0	67.0	good	
19 *Pisc.*	220	Aug. 3	"	2	"	"	....	4.0	11 52	240	....	20	"	......	61.0	fair	
7 *Schj.*	227	" 18	"	2	"	"	....	5.0	10 55	320	....	....	....	......	......	......	
19 *Pisc.*	230	" 24, 25	"	2	Erythro	Y. R.	....	6	10 35 9 20	610	120	150	*Fe* Spark	71.0	67.0	good	
D. M. 57° 702	232	" 27	"	1	C. I. I.	Y. G.	....	6.0	12 45	185	....	5	"	......	62.0	......	
280 *Schj.*	234	Sept. 7	"	1	"	"	....	3.0	7 52	505	5	5	"	57.0	55.0	fair	
19 *Pisc.*	242	" 27	Refl. Pr	13	"	"	....	8.0	10 55	60	....	5	Moon	......	......	"	Solar Spectrograph.
19 "	241	Oct. 26	"	13	"	"	....	8.0	7 44	60	3	5	"	33.0	......	"	
280 *Schj.*	245	" 26	"	13	"	"	....	8.0	10 50	300			γ *Cass.*	......	30.2	"	
280 "	246	Oct. 31 and Nov. 1	1 D. F.	1	"	"	....	7	5 56 6 00	390		180 60 5	γ *Cass.* *Fe* Spark	 47.0	 43.0	 "	
132 "	250	Dec. 22	3 D. F.	1	"	"	....	3.2	14 47	190	14	15	"	−1.1*	−3.0*	"	Temperature in prism box hereafter in degrees Cent.
318 *Birm.*	253	" 26	"	1	"	"	....	4.2	13 44	240	10	10	"	− 2.5	− 2.0	"	
19 *Pisc.*	257	" 28	"	1	"	"	....	4.0	5 17	266	7	7	"	− 4.3	− 1.2		
19 "	259	" 29	"	1	"	"	....	3.2	5 10	50	10	....	"	+ 5.6	......		
19 "	262	" 30	"	1	S. G. E.	Blue	....	5.0	5 12	252	3	4	"	−11.2	−16.0	"	
132 *Schj.*	263	" 30	"	1	"	"	....	5.0	13 55	240	3	3	"	−18.0	−20.6	"	
19 *Pisc.*	264	" 31	"	1	"	"	....	5.0	5 00	180	3	3	"	−16.0	−17.0	"	
		1899															
78 *Schj.*	267	Jan. 4	"	1	"	"	....	5.0	7 42	245	3	4	"	− 7.0	−11.4	"	
152 "	268	" 4	"	1	"	"	....	5.0	12 05	245	4	4	"	−11.5	−12.7	good	
19 *Pisc.*	269	" 6	"	1	C. I. I.	Y. G.	....	3.0	5 20	115	7	8	"	−10.4	−13.0	fair	
74 *Schj.*	270	" 6	"	1	"	"	....	4.0	7 50	165	7	6	"	−13.0	−13.0	"	
51 "	272	" 10, 11	"	1	"	"	....	4	8 10 6 13	187	4	6	"	− 5.6	− 4.0	good	
280 "	274	" 14	"	1	"	"	....	6.0	5 26	540	?	?	"	+ 1.0	+ 0.6	fair	
152 "	275	" 14	"	1	"	"	....	4.0	15 15	119	10	15	"	+ 0.4	− 0.3	"	
318 *Birm.*	276	" 15	"	1	S. G. E.	Blue	....	5.0	7 30	360	10	8	"	+ 1.0	+ 0.7	good	
115 *Schj.*	277	" 15	"	1	C. I. I.	Y. G.	....	4.0	14 30	160	10	7	"	+ 0.6	0.0	"	
115 "	278	" 18	"	1	"	"	....	4.0	12 40	280	12	....	"	− 7.3	− 9.0	fair	
19 *Pisc.*	283	" 20	"	1	"	"	....	4.0	5 17	30	10	10	"	+ 2.0	+ 2.0	"	
318 *Birm.*	284	" 20	"	1	"	"	....	4.0	9 48	255	8	10	"	+ 1.0	......	"	
152 *Schj.*	285	" 20	"	1	"	"	....	4.0	14 12	45	8	....	"	+ 3.0	......	poor	
124 "	286	" 23	"	1	"	"	....	5.0	11 40	230	4	4	"	− 3.0	......	"	
132 "	290	" 26	"	1	"	"	....	4.0	11 30	118	7	8	"	−14.0	−15.5	fair	
152 "	291	" 26	"	1	"	"	....	4.0	13 50	135	7	11	"	−15.5	−16.5	"	
19 *Pisc.*	293	" 27	"	1	"	"	....	4.0	5 55	125	8	6	"	−11.2	−11.5	good	
78 *Schj.*	294	Feb. 10	"	1	"	"	....	4.0	9 30	230	7	8	"	−21.0	−22.0	"	
229 "	295	" 10	"	1	"	"	....	5.0	14 35	225	12	12	"	−23.0	−23.3	fair	

Star	No.	Date	Disp.	Camera	Plate	Region	H. A. Mid.	Slit	Hour Beg.	Exp.	Comp. Spectrum Beg.	Comp. Spectrum End	Comp. Spectrum Kind	Temp. Beg.	Temp. End	Seeing	Remarks
		1899							h m	m	s	s		C.	C.		
78 *Schj.*	297	Feb. 15	3 D. F.	1	C. I. I.	Y. G.	....	5.0	9 50	242	11	16	*Fe* Spark	+ 0.2	− 3.0	fair	
229 "	298	" 23	"	1	"	"	....	5.0	13 55	245	10	15	"	−10.2	− 8.8	poor	
132 "	299	March 5	"	1	"	"	....	4.0	10 32	165	7	8	"	− 6.7	−10.0	"	
78 "	300	" 6	"	1	"	"	....	5.0	7 30	250	7	8	"	−13 1	−14.2	fair	
132 "	301	" 6	"	1	"	"	....	5.0	11 49	160	8	8	"	−14.2	−15.2	"	
152 "	302	" 6	"	1	"	"	....	5.0	16 03	110	8	8	"	−16.4	−16 4	"	
229 "	307	" 22	"	1	"	"	....	5.0	11 45	335	8	....	"	− 5.3	− 8.5	"	
132 "	309	" 23	"	1	S. G. E.	Blue	....	5.0	10 00	225	10	10	"	− 6 4	− 8 2	"	
152 "	316	" 31	"	1	"	"	....	5.0	12 15	300	7	9	"	− 5 5	− 7 0	good	
132 "	319	April 12	"	1	"	"	....	5.3	7 18	300	11	11	"	+18.0	16.2	fair	
152 *Schj.*	322	May 4	"	1	C. I. I.	Y. G.	......	10.0 5.0	9 47	30 10	....	....	....	15.0	......	good	
152 "	323	" 4	"	1	"	"	....	2.0	10 31	30	....	....	....	.	16 0	"	
152 "	324	" 4	"	1	S. G. E.	Blue	....	6.0	11 20	300	7	8	. ...	14.0	11.8	fair	
152 "	326	" 10	"	1	C. I. I.	Y. G.	....	5.0	9 30	1 2 4	....	....	....	15.0	......	"	
152 "	327	" 10	"	1	"	"	....	5.0	9 40	8 16	....	....	....	...	......	good	
152 "	328	" 10	"	1	S. G. E.	Blue	....	6.0	10 23	335	7	6	*Fe* Spark	14.5	10.0	"	
155b "	329	June 7	"	1	C. I. I.	Y. G.	....	5.0	8 20	432	7	7	"	20.0	15 7	"	
249a "	332	July 5	"	1	"	"	....	4.0	9 00	350	20	19	"	20.8	17.8	"	
19 *Pisc.*	334	" 20	"	1	"	"	....	4.0	13 10	165	24	...	"	23.5	22.5	poor	
19 "	336	Aug. 24	"	1	S. G. E.	Blue	....	5.0	12 08	120	3	..	*Ti* Spark	20.0		fair	
19 "	337	Sept. 13	"	1	"	"	....	4.0	9 03	270	4	3	"	14 2	12.2	"	
19 "	343	Oct. 4	"	1	"	"	1 15 E.	3.0	7 05	285	2	2	"	14 8	12.0	good	
78 *Schj.*	344	" 4	"	1	"	"	2 30 E.	4.5	12 17	310	2	2	"	12 0	10.0	"	
280 "	345	" 12	"	0	"	"	3 00 W.	5 0	10 12	180	1	....	"	18 0		"	
280 "	346	" 18	"	0	Crown	"	1 30 W.	5 0	10 08	200	1	....	"	8 0	. ..	fair	
19 *Pisc.*	355	Dec. 7	"	1	"	"	1 10 W.	4.5	4 55	325	2	2	"	3.8	2.0	"	
132 *Schj.*	356	" 18	1 L. F.	1	"	"	....	5.0	15 54	155	....	....	....	......		"	
19 *Pisc.*	357	" 19	3 D. F.	1	C. I. I.	Y. G.	1 10 W.	3.0	5 07	195	10	10	*Ti* Spark	− 3.0	− 3.8	good	
51 *Schj.*	358	" 19	"	1	"	"	0 30 W.	4.5	9 20	280	8	8	....	− 4 0	− 5.4	poor	
115 "	359	" 19	"	0	Crown	Blue	1 45 W.	4.5	15 00	210	1	..	*Ti* Spark	− 5.5	... .	fair	
280 "	360	" 21	"	0	"	"	3 30 W.	5.0	5 56	420	1	1	"	+ 3.8	+ 1.2	good	
115 "	361	" 21	"	0	"	"	1 20 W.	5.0	13 29	305	1	1	"	+ 1.2	− 0.8	fair	
51 "	362	" 26	"	0	"	"	....	5.2	8 33	65	....	....	"	− 9.0	......	"	
115 "	363	" 26	"	0	"	"	1 00 W.	6 0	12 25	330	....	2	"	−10.8	−13.6	"	
51 "	364	" 27	"	0	"	"	0 30 E.	5.0	7 18	310	...	1½	"	− 8.4	−10.0	"	
115 "	365	" 27	"	1	C. I. I.	Y. G.	1 45 W.	5.0	13 26	305	15	15	"	−19.5	−13.4	"	
280 *Schj.*	366	" 28	"	1	"	"	5 00 W.	6 0	5 39	555	10	15	"	−12.0	−16.2	"	
280 "	367	" 29	"	0	Crown	Blue	4 00 W.	6.0	5 10	480	1	1	"	−14.0	−18.5	"	
132 "	368	" 29	"	1	"	"	0 30 W.	5.0	13 42	315	2	2	"	−18 4	−19.0	"	
19 *Pisc.*	369	" 30	1 L. F.	1	"	"	2 30 W.	5.0	5 55	185	....	1	"	−16.0	−18.5	"	
		1900															
280 *Schj.*	370	Jan. 2	3 D. F.	1	C. I. I.	Y. G.	5 30 W.	6.0	5 07	660	10	....	"	− 5 5	− 6.2	good	
51 "	371	" 4	"	0	Crown	Blue	1 10 E.	5.0	6 30	300	.	½	"	+ 2.0	− 0.7	fair	
51 "	372	" 5	"	1	C. I. I.	Y. G.	.....	5.0	7 27	300	10	9	"	+ 0.9	− 0.5	good	
74 "	373	" 7	"	1	"	"	2 20 E.	5.0	6 20	300	8	7	"	+ 3.9	+ 1 6	"	
115 "	374	" 7	"	1	"	"	2 00 W.	5 0	12 48	310	7	7	"	− 3 2	− 2.2	"	
152 "	375	" 21	"	1	Erythro	Y. R.	2 20 E.	6.0	10 43	360	300	240	"	+ 1.8	+ 1.0	fair	
51 "	377	" 24	"	1	C. I. I.	Y. G.	0 15 E.	5 0	5 35	310	7	7	"	+ 5 2	+ 4.3	"	
71 "	378	" 25	"	1	"	"	1 20 E.	5.0	6 00	320	7	7	"	−10.0	−10.8	poor	
318 *Birm.*	379	" 25	"	1	"	"	0 40 W.	5.0	12 27	280	7	7	"	−14.0	−14.3	fair	
229 *Schj.*	380	" 30	"	0	Crown	Blue	7 00 E.	5.0	13 05	305	1½	..	"	−21.3	−21.0	"	
115 "	382	" 31	"	0	"	"	1 40 W.	5 0	10 20	380	....	1	"	−20.0	−22.0	"	
74 "	383	Feb. 1	"	1	"	"	2 20 W.	5 0	8 30	370	1½	1½	"	−14.0	−14.0	good	
78 "	384	" 9	"	1	C. I. I.	Y. G.	.....	5.0	10 15	260	7	13	"	−12 0	−11.8	poor	
280 "	385	" 15	"	0	Crown	Blue	5 00 W.	5.0	6 15	330	....	1½	"	−16 0	−18 5	"	
74 "	386	" 16	"	1	C. I. I.	Y. G.	2 15 W.	5.0	6 45	255	7	6	"	−17 0	−18 3	fair	
74 "	387	" 19	"	1	"	"	0 30 W.	5 0	7 00	195	6		"	− 7.0	− 7.4	"	
280 "	388	" 25	"	0	Crown	Blue	8 00 W.	5.0	6 20	360	1	1	"	−12 0	−16.8	good	
74 "	390	March 6	"	1	"	"	2 20 W.	5.0	6 40	390	4	2	"	− 7.0	− 9.2	"	
71 "	391	" 7	"	1	"	"	2 20 W.	5.0	6 22	380	3	2	"	− 2 3	− 4 1	"	
78 "	392	" 21	"	1	"	"	2 45 W.	5 0	6 47	315	2	2	"	− 0.5	− 0.1	fair	
318 *Birm.*	393	" 31	"	1	"	"	2 15 W.	5 0	10 35	220	2	2	"	+ 2 8	......	"	
152 *Schj.*	394	April 4	"	1	"	"	2 40 W.	4.0	11 55	300	2	2	"	+ 4 0	+ 2.9	good	
249a "	395	Aug. 8	"	1	C. I. I.	Y. G.	....	4 0	9 20	330	6	6	"	28 8	24.8	"	
249a "	396	" 19	"	1	"	"	2 40 W.	4.2	12 37	243	6	6	"	26 0	24.9	"	
249a "	397	" 26	"	1	"	"	....	3.2	12 52	135	5	6	"	19 6	18 7	"	
229 "	398	" 31	"	1	"	"	....	4.3	8 20	445	5	6	"	25 0	23.4	"	
152 "	478	1901 April 8	"	1	Erythro	Y. R.	2 40 W.	5.0	11 41	300	200	380 180	*H* Tube *Ti* Spark	....	3 0	"	
229 "	490	Oct. 24	"	A	Crown	Blue	1 00 W.	4.0	7 00	360	55 2	20 1	*Fe* Spark *Ti* Spark	11.9	11 9	fair	**Bruce Spectrograph**
152 "	A313	1902 Feb. 10	"	"	27 G. E.	"	2 50 E.	4 1	9 15	360	2	2½	*Ti*	− 7 4	− 7 3	good	" "
152 "	319	" 18	"	"	"	"	3 00 E.	4 0	8 25	390	2	2	"	− 6 8	6 9	g.to f.	" "
132 "	328	" 21	"	"	"	"	.....	4.1	9 30	330	½	1½	"	− 1 2	− 1.2	good	" "
249a "	R 27	July 22	1 L. F.	1	C. I. I.	"	1 00 E.	3 0	11 00	190	....	10	"	......	....	"	**24-inch Reflector**
19 *Pisc.*	31	Oct. 19	"	1	27 N. H.	"	....	4.0	6 50	330	30	15	Moon	......	......	fair	" "
19 "	35	" 24	"	0	"	"	....	4 0	6 50	70	....	½	Sky	......	......	"	" "
19 "	37	" 30	"	0	"	"	....	4.0	5 55	465	....	¼	"	......	......	good	" "
19 "	38	Nov. 18 to 23	"	0	"	"	....	5 0	6 ±	1480	....	⅛	"	......	......	fair	" "

Seed's Gilt Edge (S. G. E.) plates were also used in some cases. The slit-width is expressed in divisions of the head: one division = 0.025 mm. A spark between iron poles was usually employed for the comparison spectrum, part of the exposure being given before, part after, the exposure for the star. A titanium spark was used in the later work. The temperature in the prism box was recorded at the beginning and at the end of the exposure. Most of the exposures were made by Mr. Ellerman.

APPEARANCE OF THE SPECTRA ON THE PHOTOGRAPHS

The spectra were photographed in four sections, as follows:

1. λ 3930 to λ 4380. These photographs were taken on Seed 27 non-halation plates with a single light flint prism and a camera of 151 mm. focal length, used in conjunction with the two-foot reflector. They were made for the special purpose of showing the very faint region in the extreme violet part of the spectrum, and some of them are therefore overexposed in the blue.

2. λ 4380 to λ 4980. Most of these photographs were taken with three dense flint prisms and a camera of 271 mm. focal length. Cramer Crown plates were usually employed. With the aid of the correcting lens, the color curve of the forty-inch objective, which is very steep in this region, was flattened out sufficiently to give fairly uniform illumination through the middle part of the spectrum. At both ends, however, the brightness falls off somewhat on account of the change in focus. In the less refrangible region these spectra are further weakened by the fact that the plates are relatively insensitive for light of these wave-lengths. It will be seen from these and other facts that the region of the spectrum lying between λ 4900 and λ 5160 is not well represented on most of our photographs.

3. λ 5160 to λ 5800. The greater part of these photographs were taken with three dense flint prisms and a camera of 271 mm. focal length on Cramer isochromatic plates. As already remarked on p. 7, the form of the color curve of the forty-inch objective and the fall in sensitiveness of the plates in this region cause these photographs to be relatively underexposed at the more refrangible end, though the focus was set for λ 5000. Little is shown beyond λ 5800, as the isochromatic plates decrease rapidly in sensitiveness in this region.

4. λ 5630 to λ 6600. Photographs of the spectra of 152 *Schjellerup* and 19 *Piscium* were obtained in this region with a single dense flint prism and a camera of 508 mm. focal length on Erythro plates.

In studying the photographs, it is necessary to bear in mind the fact that the various adjustments required in photographing the spectra in sections necessarily introduce differences of relative intensity, and render it almost impossible to determine accurately the distribution of brightness throughout the spectra. In the following description of the photographs it is to be understood, therefore, that the appearances described relate to the plates themselves, and not to the spectra as seen visually in a telescope.

General characteristics.— The most striking features of spectra of the fourth type are the dark bands attributed to the compounds of carbon. The principal bands have their less refrangible edges at λ 4737.8, λ 5167.9, and λ 5636.9. Bright zones, consisting of bright lines and strong continuous spectrum, appear on our plates on the less refrangible side of the first and last of these heads;[13] and bright and dark lines are found in connection with the continuous spectrum throughout the region photographed. The fluted character of the carbon bands is strikingly evident in the region λ 5500–λ 5637, especially in such stars as 132 *Schjellerup;* it also appears in the other carbon bands when the exposures are suitable, and in the cyanogen band at λ 4502–λ 4606 (see Plate VII).

Details.— The violet region of the spectra of fourth-type stars is so faint that it can be photographed only with the greatest difficulty. On account of the form of the color curve and the absorption in the violet of the forty-inch objective, no attempt was made to include the extreme violet on plates taken with the large refractor. It was nevertheless deemed of great importance to determine whether the H and K lines and the $H\gamma$ and $H\delta$ lines were present, and also to render possible the comparison of fourth-type with third-type spectra in the violet region. For this reason a few photographs of the spectra of 19 *Piscium* were made, as described above, with the two-foot reflector. The most prominent features of these photographs are the very strong calcium line at λ 4227 and the H

[13] The brightness of the region on the less refrangible side of the carbon head at λ 5167.9 is reduced on our photographs for the reasons given above.

and K bands, which are very conspicuous. Less prominent, but nevertheless unmistakable, are the dark hydrogen lines $H\gamma$ and $H\delta$, as well as the G group and two conspicuous lines at λ 4058 and λ 4384 (Figs. 1 and 2, Plate X).

The presence of dark $H\gamma$ and $H\delta$ lines renders the existence of a bright $H\beta$ line in the photographs taken with three prisms a matter of great interest. The comparatively large scale of these spectra and their sharpness of definition leave no doubt as to the presence and identification of lines in this region. In two or three stars $H\beta$ appears as a bright line, and in this character it is the most striking feature of the spectrum of 280 *Schjellerup*. In several of the stars, however, $H\beta$ is altogether absent, and in no case do we find it present as a dark line. The bearing of these results on the physical condition of hydrogen in the fourth-type stars is discussed elsewhere (p. 126).

The cyanogen flutings, with heads at λλ 4608.9, 4578.4, 4553.3, 4515, and 4503.2, are characteristic features of all the fourth-type spectra we have examined, including 280 *Schjellerup*. In each fluting the continuous spectrum grows stronger toward the blue, but the bright lines in this region are scattered with less regularity than in the yellow flutings. From the more refrangible edge of the bright blue zone at λ 4738.6 the continuous spectrum, here of maximum brightness, gradually decreases in intensity toward λ 5000. Between this zone and the head of the dark carbon band at λ 4737.8 there are two unidentified flutings in the spectrum of 152 *Schjellerup*, but in most of the other stars only one of these flutings appears. The most prominent dark lines are those at λλ 4408, 4435, 4497, 4506, 4523, and 4535. Between λ 5000 and λ 5169 the carbon absorption is nearly complete, and for various other reasons already given few details are shown in our photographs of this region. Nevertheless, the carbon heads at λ 5099 and λ 5129 can be recognized in 229 *Schjellerup* (Fig. 1, Plate VII).

In the green and yellow the continuous spectrum decreases in intensity from the maximum near the *b* group and attains its minimum brightness in the absorption of the yellow carbon bands. These flutings have heads at λλ 5638.8, 5587.7, and 5505.5, and form the most characteristic feature of the spectrum. Each is made up of bright and dark lines, the bright lines being strongest at the more refrangible part of each fluting, while the dark lines are broadest and strongest at the less refrangible edge. For various reasons, discussed elsewhere, this effect, in some cases, at least, appears to be due to the presence of genuine bright lines, and not merely to contrast. Other bright lines, the character of which cannot be doubted, occur in the green region, where they are very conspicuous on the original negatives. The bright yellow zone also contains a large number of bright lines, lying on a less brilliant background of continuous spectrum. In 280 *Schjellerup* the bright lines are inconspicuous. The broad dark line λ 5620–5638 is double, and the component λ 5620–5626 contains three vanadium lines. In 280 *Schjellerup* this double line is the only well-marked trace of the yellow carbon band. In 19 *Piscium* the entire set of flutings is easily recognized, and they increase in intensity as we pass to 318 *Birmingham*, 74, 78, and 132 *Schjellerup*, while in 152 *Schjellerup* they are less noticeable, apparently from increased carbon absorption, which cuts down the contrast. The most conspicuous dark lines in this part of the spectrum have the wave-lengths λλ 5226, 5329, 5350, 5371, 5397, 5410, and 5447. The last pair of lines has a curious appearance, resembling that of a symmetrical reversal. The *b* lines are conspicuous in all of the stars. In the more fully developed stars the group λ 5204–5211 becomes the most prominent feature in this part of the spectrum. The *b* group also becomes stronger, but b_3 and b_4 are nearly lost in the carbon absorption band whose head is at λ 5169.1.

The more refrangible part of the spectrum is shown in a few photographs obtained with Erythro plates. The D line appears strong and dark, but it is not divided, as the plates were taken with one prism. The continuous spectrum is fairly strong from the sodium line to a dark line at λ 5732, which separates this part from the bright yellow zone, λ 5637–5726. In the region λ 6086–6340 the bright lines and strong continuous spectrum form a bright zone. There are two unmistakable bright lines at λ 6176 and λ 6201, and also two which are less certainly bright at λ 6108 and λ 6131. There

is a strong bright line at λ 6270, and two or three probably bright lines in the interval λ 6275–6340. There is also a dark line at λ 6358. At λ 6445 there is possibly a bright line. From this point the continuous spectrum greatly decreases in intensity until its limit is reached at λ 6600 (Fig. 1, Plate VI).

Certain peculiarities in the spectrum of 152 *Schjellerup* are referred to on p. 131.

THE PRESENCE OF BRIGHT LINES

In his memoir *Sugli Spettri Prismatici delle Stelle Fisse*, and in his treatise *Le Soleil*, Secchi refers in several places to the existence of bright lines in the spectra of fourth-type stars:

> Non mancano in queste stelle (152 *Schjellerup*) delle righe brillanti come le metalliche, ed è singolare che esse si mostrano nella estremità più viva delle zone colorate. Gli spettri di queste stelle hanno più che gli altri analogia coi gas, e specialmente con quello del carbonio, ma rovesciato.[14]
>
> Avvertimmo già che in alcune vi sono delle righe vive assai simili alle metalliche, le quali spiccano assai; alcune nel giallo paiono fili d'oro.[15]

Such references would seem to leave no doubt that Secchi saw some of the bright lines whose existence is shown by our photographs. His intensity curve of the spectrum of 78 *Schjellerup* (Fig. 1)[16] places two of the bright lines in the yellow not far from their true positions, though the less refrangible of these two lines should be given much greater intensity than the more refrangible one. But the illustration of the spectrum of the same star published later by Secchi in the second edition of *Le Soleil* (Plate M) contains no bright lines, while the drawing of the spectrum of 152 *Schjellerup* in the same plate shows two narrow bright lines in each of the three bright zones, but omits the strong bright lines in the yellow carbon band. Moreover, in describing the spectrum of 132 *Schjellerup*, Secchi remarks:

FIG. 1

> Tipo 4° ben deciso con due forti righe lucide nel giallo assai vive e che sono da misurare se fosse il sodio.

Other intensity curves given by Secchi show, as Dunér has pointed out in his memoir,[17] that in some cases the supposed bright lines probably refer to the broad yellow sub-zone, the width of which is not less than ninety tenth-meters. Thus in describing the spectrum of 136 *Schjellerup*, whose intensity curve is reproduced in Fig. 2 from the *Memoria Seconda*, p. 44, Secchi remarks:

FIG. 2

> Lo spettro è analogo alla 132, ma in parte diverso: ha una forte riga doppia viva nel giallo, poi segue una zona scura.

As Dunér states:

> Secchi s'est plus tard persuadé, par des mesures, que les deux raies jaunes n'ont pas la même position que celles du sodium, mais il est néanmoins difficile de comprendre comment il a pu croire que cette zone, quarante fois plus large que la distance entre D_1 et D_2, fût les raies du sodium.

On the whole, it is hardly probable that Secchi actually distinguished the true bright lines, though he was so much impressed by the appearance of the bright zones that he remarked:[18]

> Le spectre dans son ensemble se présente comme un spectre direct appartenant à un corps gazeux, plutôt que comme un spectre d'absorption.

In this connection it is an interesting fact that Pickering in his early visual surveys of stellar spectra states that a normal fourth-type spectrum "consists of a well-defined yellow band, a broad green band well defined on the more refrangible side and generally less sharply bounded on the other, and a blue band in some cases well defined toward the violet."[19]

[14] *Memoria Seconda*, p. 9.

[15] *Ibid.*, p. 12.

[16] Reproduced from his *Memoria Seconda*, p. 40; the red end of the spectrum is at the left.

[17] *Loc. cit.*, p. 10.

[18] *Le Soleil* (2d ed.), Vol. II, p. 458.

[19] *A. N.* 2376.

Dunér quotes Secchi's statements regarding bright lines in his memoir,[17] but states that he has never seen the least thing which could explain Secchi's belief in bright lines, and remarks that Vogel was not more fortunate. At that time he also considered that the spectrum was incontestably an absorption spectrum, and Vogel entertained the same view:

Es stellt sich unzweifelhaft heraus, dass die Discontinuität des Spectrums nur eine scheinbare ist, hervorgebracht durch breite Absorptionsbanden.[20]

More recently, Dunér has observed the spectra of these stars with a telescope having a Steinheil visual objective of 36 cm. aperture, and remarks: "Of first importance is the fact that I was able to detect without difficulty bright lines in various spectra which at Lund were either invisible or at least could not be discovered."[21] The detailed observations given in this paper show that a bright line (probably the one at λ 5592) was seen by Dunér in the spectra of all of the brighter stars.

Our earliest photographs of the spectra of fourth-type stars, made before the publication of Dunér's second paper, seemed to show without question the presence of bright lines. But as Dunér had expressed so decided an opinion against their existence, and as his conclusions had been supported by the results of Vogel's observations, it seemed desirable to undertake a series of tests for the purpose of meeting any doubts that might arise.

As shown on the photographs, the numerous bright lines in these spectra appear decidedly stronger than the continuous spectrum in their neighborhood, and prove their superior brightness by extending out on either side of the general spectrum, thus showing their power of impressing the plate at points where the continuous spectrum was too faint to do so. The evidence thus afforded as to the genuineness of the bright lines is not preserved in the widened photographs of the plates, but is fairly well shown in a direct enlargement of the spectrum of 132 *Schjellerup* reproduced in Plate V.

The following tests were employed to determine the genuineness of the bright lines:

1. It was found that an exposure of four minutes was sufficient to photograph the bright line at λ 5592 in the spectrum of 152 *Schjellerup* with a dispersion of three prisms, while equal density of the contiguous spectrum could not be obtained under the same conditions with an exposure of less than from twelve to fifteen minutes. If the line is supposed to be due to the continuous spectrum, it must be assumed that the heavy carbon absorption band is interrupted at this point. It is true that the line falls close against the second head of the fluting, and therefore at a point where the absorption band would be weakest. But the bright line appears to be sharply bounded on both sides, whereas it should fade away gradually toward the red if it were due to decreased absorption.

2. By increasing the dispersion an apparent bright line, if really due to continuous spectrum bounded by portions of the carbon absorption band, should be rendered less conspicuous. In our experiments it was found, however, that the contrast between the bright lines and the contiguous spectrum increased rather than diminished with the dispersion, and that the lines were best observed both visually and photographically with our most powerful combination of three heavy flint prisms.

3. Similarly, an increase in slit-width should tend to reduce the contrast if the effect were due to continuous spectrum bounded by dark lines or bands. In practice, however, the bright lines were admirably shown with the widest slits, and increase of slit-width did not seem to reduce the contrast.

Although there can be no doubt as to the presence of iron and other metals in these stars, it will be seen from inspection of the detailed comparisons on pp. 117–22 that many of the strong lines of these substances are absent. A large part of these can be accounted for, however, if it is assumed that they are hidden by overlying bright lines.

Photographic observations alone were not allowed to settle the matter, and on many occasions the spectra of 132 *Schjellerup* and 152 *Schjellerup* were examined visually with the three-prism spectroscope attached to the forty-inch telescope. With an observing telescope having a focal length of 253 mm. and an eyepiece magnifying thirteen diameters, the bright line at λ 5592 was easily seen,

[20] *A. N.* 2000.

[21] "On the Spectra of Stars of Class III*b*," *Astrophysical Journal*, Vol. IX (1899), p. 121.

as well as a number of other bright lines in the red, yellow, green, and blue. Under the same circumstances some of the more conspicuous dark lines were seen without much difficulty, but the less conspicuous ones were not visible.

As a further precaution, we requested Professors Keeler and Campbell to observe the spectrum of 152 *Schjellerup* with the thirty-six-inch refractor of the Lick Observatory. They did so, using a dispersion of three prisms, and Professor Keeler reported his observations as follows:

I compared the spectrum with Vogel's drawing in *Potsdam Publications*, Vol. IV. The drawing seemed to be merely a rough indication of what the spectrum actually is. What we saw was much more like your photograph. It is curious that Vogel did not see the bright line λ 550 ±, as it is a conspicuous feature of the spectrum with the thirty-six-inch. The bright block λ 553 − λ 584 seems to be a complex of bright and dark lines or bands, and the dark band as shown in the drawing (λ 573) is relatively too conspicuous. Vogel's dark band at λ 525 is made up of lines, of which there are many in the neighborhood. There is a strong line at or near D. We tried to identify it with the *Na* line in a spirit lamp, but the telescope was jumping in a high wind, and the comparison did not amount to much. There were many dark lines in the red.

To my mind, there is little doubt that the spectrum of this star contains bright lines.

These results are in striking contrast with those obtained by Sir Norman Lockyer, and reported by him in his article, "The Piscian Stars": [22]

The Kensington observations were made chiefly during 1894 and 1895, with special reference to the lines involved. The stars selected for observation were 132 *Schjellerup*, 152 *Schjellerup*, 115 *Schjellerup*, and 19 *Piscium*. The 3-foot reflector was used. In addition to the carbon bands, numerous lines were seen without much difficulty, but only the more prominent ones could be satisfactorily measured. Among the lines recorded in 132 *Schjellerup* were $H\beta$, the E line of iron at 5269, and a group of lines near λ 5380. In 115 *Schjellerup* additional lines were measured near 5005, 5762, and 5429, and the presence of $H\beta$ was again determined by comparison with a hydrogen vacuum tube. In 19 *Piscium* numerous lines were observed, among them being D and F. No suspicion of bright lines was entertained during these observations. Attempts to photograph the spectra were not sufficiently successful to help matters.

A three-foot reflector should be admirably adapted for the investigation of these stars, whether visually or photographically. And yet the bright lines, which should have been easily visible, were not seen, while $H\beta$ was recorded as a dark line in 132 *Schjellerup*, 115 *Schjellerup*, and 19 *Piscium*. As a matter of fact our photographs show no dark $H\beta$ line in any of these stars.

In discussing the probability of the existence of bright lines on our photographs, Lockyer was at a disadvantage, as he had not seen the original negatives, and the few published reproductions did not adequately represent the facts. As Fig. 3, Plate V, shows, the bright lines are distributed all through the spectrum, and are by no means confined to the edges of flutings, where Lockyer thinks contrast effects would sufficiently account for the appearance of the photographs.[23]

In the table of mean wave-lengths (p. 92), which contains 213 bright lines, we have included only those lines which were regarded as unquestionably bright by at least two independent observers. In some cases, where the brightness of the line is but very little greater than that of the continuous spectrum, there might easily be some room for doubt, and many lines of this character have accordingly been excluded from the table. In many other cases, on the contrary, the bright lines are so much stronger than the continuous spectrum that the most critical observer of the original negatives would not hesitate for a moment to distinguish them from mere spaces between dark lines. We may add that the judgment of a large number of spectroscopists who have examined the negatives coincides entirely with our own.

MEASUREMENT OF THE PHOTOGRAPHS

As it seemed more important, in the existing state of the subject, to examine thoroughly a small number of photographs than to study a large number of spectra less completely, the following plates were selected for detailed measurement:

[22] *Proc. Roy. Soc.*, Vol. LXVI, p. 137.

[23] The bright lines are unduly conspicuous in Fig. 2, Plate VI, as the contrast of the plate was increased in copying.

LIST OF PLATES MEASURED

Star	Plate	Date			G. M. T.	Exp.	Hour-angle	Qual.	Comp. Spec.	
									Kind	Qual.
		y	m	d	h	m				
19 *Piscium*	G 259	1898	12	29	11.6	50	W 0.6	C	*Fe*	B
	G 264	1898	12	31	12.5	180	W 1.6	C-B	*Fe*	C
	G 269	1899	1	6	12.3	115	W 1.9	A	*Fe*	C
	G 293	1899	1	27	13 0	125	W 3.9	A B	*Fe*	B
	G 343	1899	10	4	15.5	285	E 1.3	B	*Ti*	A
	G 357	1899	12	19	12.8	195	W 1.2	A	*Ti*	A
	R 31	1902	10	19	15.6	330	E 0 3		Moon	
	R 37	1902	10	30	15.8	465	W 0.7		Sky	
	R 38	1902	11	18, 19, 22, 23	15±	1480	0 ±		Sky	
280 *Schjellerup*	G 346	1899	10	18	16.1	200	W 1.5	C	*Ti*	B
	G 366	1899	12	28	11.6	565	W 5 ±	B C	*Ti*	B
	G 367	1899	12	29	11 2	480	W 4 ±	C	*Ti*	B
	G 370	1900	1	2	11.1	660	W 5.5	C	*Ti*	B
318 *Birmingham*	G 253	1898	12	26	21.7	240	E 0.5	B	*Fe*	B
	G 276	1899	1	15	16.4	360	E 4.4	B	*Fe*	B-C
	G 284	1899	1	20	17.8	255	E 2.7	B	*Fe*	B-C
	G 379	1900	1	25	20.7	280	W 0.4	C-B	*Ti*	B
	G 393	1900	3	31	18	220	W 2.2	A	*Ti*	B
74 *Schjellerup*	G 373	1900	1	7	15.0	300	E 2 1	A-B	*Ti*	B
	G 383	1900	2	1	17.3	370	W 1.8	C	*Ti*	C
	G 386	1900	2	16	14.8	255	W 0 3	C-D	*Ti*	B
	G 391	1900	3	7	15.5	380	W 2.3	B	*Ti*	B
78 *Schjellerup*	G 300	1899	3	6	14.8	250	W 2.0	B	*Fe*	B
	G 344	1899	10	4	20	310	E 2.8	B	*Ti*	A
	G 384	1900	2	9	18.4	260	W 2.9	B	*Ti*	B
	G 392	1900	3	21	18	315	E 2.9	A	*Ti*	B
132 *Schjellerup*	G 299	1899	3	5	17.8	165	W 0.3	B	*Fe*	B-C
	G 301	1899	3	6	19 0	160	W 1.5	A	*Fe*	A
	G 309	1899	3	23	17.8	225	W 1.4	B C	*Fe*	B-C
	G 368	1899	12	29	22.1	315	W 0 2	C-B	*Ti*	C-B
	A 328	1902	2	21	18 3	330	E 0.7	A	*Ti*	A-B
115 *Schjellerup*	G 363	1899	12	26	21.0	330	W 1.0	C-D	*Ti*	C
	G 365	1899	12	27	21.8	305	W 1.8	B	*Ti*	C
	G 374	1900	1	7	20.5	340	W 2 3	B	*Ti*	B
	G 382	1900	1	31	19.3	380	W 1 7	B-C	*Ti*	B-C
152 *Schjellerup*	G 275	1899	1	14	22.2	119	E 0 8	A	*Fe*	B
	G 291	1899	1	26	20 8	135	E 1.3	B	*Fe*	
	G 302	1899	3	6	22.8	140	W 3.3	A	*Fe*	A-B
	G 316	1899	3	31	20.7	300	W 2.7	B	*Fe*	B
	G 394	1900	4	4	17.3	300	E 2.7	A	*Ti*	B
	A 313	1902	2	10	18.3	360	E 2.8	B	*Ti*	B
	A 319	1902	2	18	17 7	390	E 3.0	A	*Ti*	A-B
	G 211	1898	7	1	17.4	350	W 5.5		*Fe*	

The other photographs, which include many excellent spectra, were used for general study and comparison.

The scale of the spectra is given in the following table:

SCALE OF THE PLATES

I. PLATES TAKEN WITH THREE PRISMS

(Camera 1)

Blue Region		Yellow-Green Region		
Wave-Length	$\frac{ds}{d\lambda}$	Wave-Length	$\frac{ds}{d\lambda}$	
t. m.	mm.	t.m.	mm.	
4400	0.054	5200	0.025	End of spectrum
4700	0.036	5500	0.019	Middle of spectrum
5000	0.026	5800	0.015	End of spectrum

SCALE OF THE PLATES—*Continued*

II. PLATES TAKEN WITH ONE PRISM

Blue Region (Camera 0)		Red Region (Camera 2)		
Wave-Length	$\frac{ds}{d\lambda}$	Wave-Length	$\frac{ds}{d\lambda}$	
4000	0.010	5800	0.011	End of spectrum
4200	0.008	6200	0.009	Middle of spectrum
4400	0.006	6600	0.007	End of spectrum

The three prisms of the old spectrograph have a visual resolving power of about 33,000 for λ 4860, but with the slit-widths employed in the present investigation only a small fraction of this is realized. In the region near λ 4400 it is possible to separate on the photograph lines 0.8 tenth-meter apart, while at λ 5600 lines 1.3 tenth-meters apart are resolved.

With the Bruce spectrograph (camera A), which was used in a few cases, the scale is:

Wave-Length	$\frac{ds}{d\lambda}$
4400	0.084
4700	0.036
5000	0.026

Method of measurement.—Four different machines were used in the measurements: the Zeiss comparator, described in our earlier paper;[24] two similar machines, Nos. 122 and 873; and the Gaertner measuring machine, described by Messrs. Frost and Adams.[25] Careful investigations have shown that the scale errors of the Zeiss comparators and the errors of the screw of the measuring machine are of the same order, not exceeding 2 μ or 3 μ. With narrow slits and spectra better defined than those here available such errors would enter appreciably. We have found it sufficient, however, to eliminate the errors as far as possible by measuring the plates at four different parts of the screw or scale and adopting the mean as the true position of the line. No difference in treatment is required for the measurements of the different machines, as the same methods were used in all cases to eliminate errors. All of the measures given in this paper (excepting those of G 211, by Mr. Ellerman) were made by Mr. Parkhurst.

The plates were adjusted on the sliding stage of the machine so that the length of the spectrum was parallel to the scale (or screw), and the cross-hair in the microscope eyepiece was made parallel to the spectral lines. Four settings were made on standard lines of the comparison spectrum, two on the lines above the star spectrum, followed by two on the lines below. For the first few plates four settings were made on the star lines, but this number was afterward reduced to three. The average number of standard lines measured on each plate was thirteen. In order to test the stability of the plate on the machine these standards were generally measured both before and after the settings were made on the star lines. A single cross-hair, running entirely across the field of the microscope, was used throughout the measures. Each plate was measured in two positions on the machine, red end toward the right and left, respectively, and the mean of the results was used.

REDUCTION OF THE MEASURES

We have described in a previous article[26] the various methods of reduction tried before we finally adopted the plan described in the present paper. These involved graphical methods, in which an interpolating machine devised for the purpose was employed, and a least-squares method based upon the use of the valuable Cornu-Hartmann interpolation formula. The results obtained by the least-squares method were entirely satisfactory, but considerable time was required to compute the

[24] GEORGE E. HALE AND FERDINAND ELLERMAN, "On the Spectra of Stars of Secchi's Fourth Type. I," *Astrophysical Journal*, Vol. X (1899), p. 102.

[25] EDWIN B. FROST AND WALTER S. ADAMS, "Radial Velocities of Twenty Stars having Spectra of the Orion Type," *Publications of the Yerkes Observatory*, Vol. II, p. 148.

[26] GEORGE E. HALE AND FERDINAND ELLERMAN, *loc. cit.*, p. 103.

constants of the formula in this way. For this reason the least-squares solution was replaced by a residual-curve method, which furnished an equally satisfactory means of correcting the approximate constants and required far less time. This method is described in the present paper.

The combination of red-right and red-left measures was effected by subtracting the mean of the red-left measures from a constant so chosen as to make the difference about equal to the mean of the red-right measures. The final mean of this difference and the mean of the red-right measures was taken as the quantity s in the Cornu-Hartmann formula

$$\lambda = \lambda_0 + \frac{c}{s - s_0} \ ,$$

in which s is the mean scale reading, λ_0, c, and s constants derived by substituting the scale readings of three standard lines for s and solving the three resulting equations, and λ is the desired wave-length. The derivation of the constants and the solution of the equation for the wave-length of each star line was greatly facilitated by the use of the Brunsviga calculating machine.

Reduction to the Sun.—The correction for the Earth's orbital velocity was made by the use of formulæ given by Dr. Schlesinger,[27] where we may put:

$$\text{Tan } \lambda = [9.96255] \tan \alpha + [9.59987] \sec \alpha \tan \delta$$
$$b = [1.47371] \sec \lambda \cos \alpha \cos \delta$$
$$c = [8.224] \text{ b} \sin (281^\circ\ 20' - \lambda).$$

For 1900 we obtain the following constants for reduction to the Sun:

Star	R. A.	Dec.	Long.	Log b	c
74 *Schjellerup*	6h 19m 46s	+14° 46.6	94° 50′	1.4689	−0.06
78 *Schjellerup*	6 29 40	+38 31.6	96 04	1.4539	−0.04
115 *Schjellerup*	8 49 45	+17 36.7	130 03	1.4734	+0.24
132 *Schjellerup*	10 32 36	−12 51.9	164 53	1.4456	+0.42
318 *Birmingham*	10 38 08	+67 56.2	125 44	1.2538	+0.01
152 *Schjellerup*	12 40 26	+45 59.2	165 34	1.3227	+0.32
19 *Piscium*	23 41 17	+ 2 56.0	356 42	1.4733	−0.50
280 *Schjellerup*	23 56 10	+59 47.9	33 45	1.2555	−0.28

The correction to the wave-length of the star lines was then

$$\Delta\lambda = V_a \left(\frac{\lambda}{299860}\right) .$$

Instead of applying this correction separately to each wave-length derived from the formula, it was combined in the following manner with the correction curve which is required when the formula is used in its approximate form, without the exponent of the denominator $(s - s_0)$:

Correction curve.—An average of thirteen standard lines were measured in the comparison spectrum on each plate. With the exception of the three lines used in deriving the constants of the formula, each line gave a correction required to reduce its wave-length given by the formula to the standard wave-length. These corrections were platted on squared paper, as shown in Fig. 3, in which the abscissæ are wave-lengths given by the formula (scale, one square equals 10 t.m.) and the ordinates are the corrections (scale, one square equals 0.01 t.m.). A smooth curve, shown by the dotted line, was drawn through these points, from which corrections could be read off for each star line. The correction required for reduction to the Sun was then laid off on the same scale as the correction curve. This is a straight line located by the values for two arbitrarily chosen wave-lengths, λ 4400 and 5000. The final correction curve, shown by the full line, was then drawn, making its ordinates the algebraic sum of the ordinates of the first curve and the reduction to the Sun. From this curve corrections were taken out and applied to the wave-length given by the formula for each star line. The correction for diurnal motion of the observer amounted to 0.005 t.m. only in the case of one plate, G 293 for 19

[27] *Astrophysical Journal*, Vol. X (1899), p. 2.

Piscium, and as only two decimals were considered in the reductions, the diurnal correction was neglected for the other plates.

Combination of results.—The negatives taken on ordinary plates covered the region λ 4370–4980; those taken on isochromatic plates, λ 5170–5850. For convenience these will be called the blue and yellow-green regions, respectively. At least two plates of a region were measured for each star,

CORRECTION CURVE

78 *Schjellerup*, Plate G 392

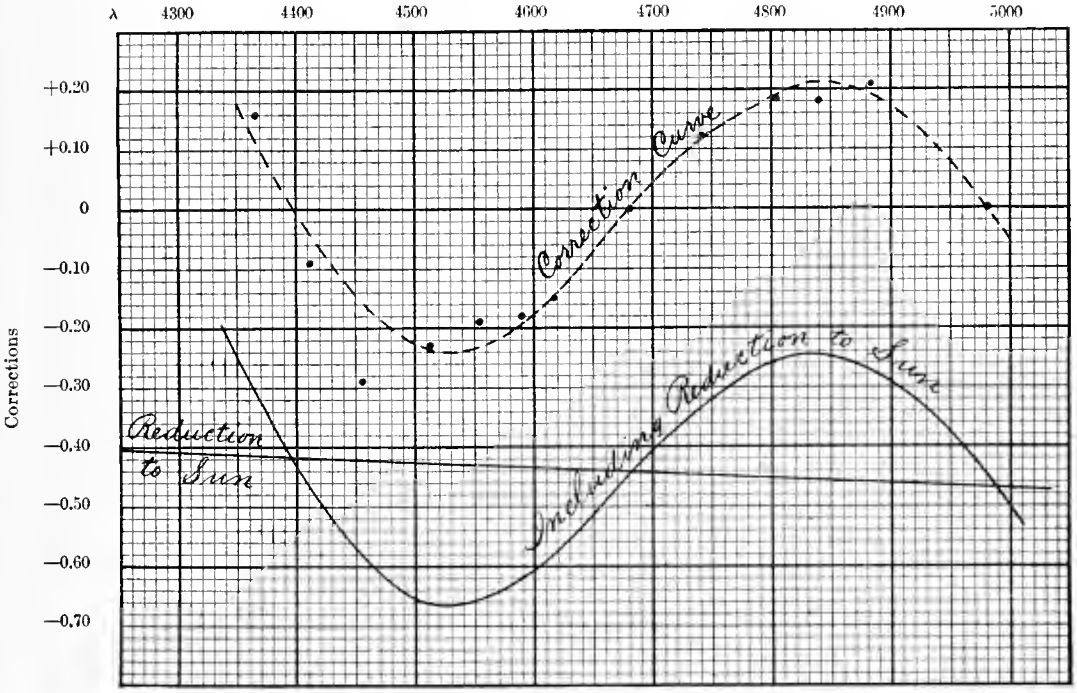


FIG. 3

and more than two if the quality of the plates required. In the case of lines measured on both plates, the mean of the results was taken as the wave-length of the line in that star, but for lines measured on only one plate the wave-length was reduced to the system of the two plates by adding to it the mean difference between the wave-lengths of the lines common to both. In the case of stars for which three or more plates were measured, the uncorrected means of the measures were taken. We thus have the following table of corrections to wave-lengths of lines found on only one plate:

CORRECTIONS TO WAVE-LENGTHS OF LINES FOUND ON ONLY ONE PLATE

Star	Region	Corrections	Basis
19 *Piscium*	blue	Mean = 264 − 0.06 = 343 + 0.06	76 lines
280 *Schjellerup*	blue	Mean = 346 + 0.09 = 367 − 0.08	24 lines
	yellow-green	Mean = 366 + 0.23 = 370 − 0.23	39 lines
318 *Birmingham*	blue	Mean = 276 + 0.03 = 393 − 0.03	57 lines
74 *Schjellerup*	blue	Used only one plate, G 391	
	yellow-green	Mean = 373 − 0.20 = 386 + 0.20	44 lines
78 *Schjellerup*	blue	Mean = 344 + 0.20 = 392 − 0.20	74 lines
	yellow-green	Mean = 300 + 0.06 = 384 − 0.06	63 lines
132 *Schjellerup*	yellow	Mean = 301 + 0.10 = 299 − 0.10	62 lines
115 *Schjellerup*	blue	Mean = 368 − 0.02 = 382 + 0.02	16 lines
	yellow-green	Mean = 365 + 0.02 = 374 − 0.01	64 lines
152 *Schjellerup*	yellow-green	Mean = 302 + 0.06 = 275 − 0.06	90 lines

Exceptions to the adopted methods.—The reductions for the six plates of 19 *Piscium* were carried out separately for the measures "red right" and "red left," and the means taken of the resulting wave-lengths, after which the correction for radial velocity was applied. To apply the correction curve to fit the formula to the wave-lengths of the standard lines, somewhat different methods were used for the first eight plates measured, six of 19 *Piscium*, and plate G 275 of the yellow-green region of 152 *Schjellerup*. On account of the poor quality of the standard lines and the effect of a neighboring air-line on the wave-length of the iron standard at λ5710.75, the true form of the correction curve for the spectrograph was masked. The frequent appearance of an air-line close to the line mentioned shifted the center from one to two tenth-meters capriciously. After this was recognized this line was no longer used in deducing the constants of the formula. To avoid re-reduction, after the true form of the correction curve was found, a second curve was drawn, and from it were taken the quantities needed to apply to the results from the first curve.

The methods used for the first seven plates can be briefly described as follows:

19 *Piscium*

G 269. Red right and left reduced separately; Cornu-Hartmann correction curve assumed as zero; reduction to Sun applied.

G 293. Red right and left reduced separately; Cornu-Hartmann curve taken as a straight line (first constants). Applied to the observed scale reading of the three standard lines, the correction from the residual curve with sign reversed, and expressed in scale divisions. Second constants, which will include the corrections from the curve, computed with these corrected scale readings. Reduction to Sun then applied.

G 259. Red left. Same as G 293.
Red right. Measured February 26 and March 1, 1901; shift found and two sets of measures reduced separately.
Reductions same as before, except that the reduction to Sun was combined with the correction from the Cornu-Hartmann (straight-line) curve.

G 357. Same as last. Same correction curve for measures right and left.

G 264. Same as last.

G 343. Shift found between measures of March 11 and 12, 1901, two parts reduced separately; otherwise same as last.

152 *Schjellerup*

G 275. Red right and left combined before reduction, otherwise same as last.

CONSTANTS OF THE PLATES

The following tables contain the constants of the plates, including the wave-lengths and mean scale readings of the standard lines, the residuals corresponding to the approximate and corrected formula, the approximate and corrected values of the constants of the formula, and the reduction to the Sun. Kayser and Runge's wave-lengths were used for the standard iron lines, and those of Hasselberg for the standard titanium lines.

On account of the special methods of reduction employed, 19 *Piscium* is given first. The stars follow in the order described on p. 19. The order in the tables of constants and in the tables of detailed measures is therefore as follows:

19 *Piscium*.
280 *Schjellerup*.
318 *Birmingham*.
74 *Schjellerup*.
78 *Schjellerup*.
132 *Schjellerup*.
115 *Schjellerup*.
152 *Schjellerup*.

PLATE G 264. 19 *PISCIUM*

Blue Region

Wave-Length *Fe*	Red Right: Mean Scale Reading	Red Right: Δ_1	Red Right: Δ_2	Red Left: Mean Scale Reading	Red Left: Δ_1	Red Left: Δ_2
t.m.	mm.			mm.		
4404.93	*48.0031*	−01	00	*37.6904*	00	+01
4447.89	45.9732	+66	+72	39.7267	+56	+62
4494.74	43.8423	+19	+28	41.8478	+18	+27
4508.38	43.2639	+43	+52	42.4344	+40	+49
4528.79	42.3876	+07	+14	43.3057	+16	+23
4549.64	41.5323	+06	+12	44.1603	+18	+24
4584.02	*40.1697*	−01	+01	*45.5275*	00	+02
4661.67	37.3202	+23	+18	48.3760	+28	+23
4705.54	35.8217	+19	+11	49.8773	+16	+08
4788.37	33.2006	+19	+13	52.4998	+11	+05
4871.90	30.7980	+22	+25	54.8975	+28	+31
4924.12	29.4009	+10	+19	56.2962	+08	+17
4957.65	*28.5432*	−01	+10	*57.1527*	00	+11
1st Constants S_0	−19.4311			105.0359		
1st Constants c	91886.800			−91580.450		
1st Constants λ_0	3042.33			3045.07		
2d Constants S_0	−19.4291			105.0339		
2d Constants c	91875.058			−91568.385		
2d Constants λ_0	3042.13			3044.89		

Reduction to Sun:		t.m.
	λ 4400	−0.43
	λ 5000	−0.49

PLATE G 343. 19 *PISCIUM*

Blue Region

Wave-Length *Ti*	Red Right, For λ 4395 to 4639: Mean Scale Reading	Δ_1	Δ_2	Red Right, For λ 4640 to 4940: Mean Scale Reading	Δ_1	Δ_2	Red Left, For λ 4395 to 4744: Mean Scale Reading	Δ_1	Δ_2	Red Left, For λ 4746 to 4979: Mean Scale Reading	Δ_1	Δ_2
t.m.	mm.			mm.			mm.			mm.		
4387.01	50.4255	+32	+09	50.4198	+21	+09	37.9330	+14	−04	37.9418	−02	−04
4427.27	48.3368	+36	+18	48.3302	+23	+18	40.0252	+12	+01	40.0317	00	−05
4468.66	*46.2929*	+03	−07	*46.2903*	−03	−07	*42.0599*	00	00	*42.0681*	−18	−02
4481.44	45.6950	+13	+06	45.6905	+03	+06	42.6623	+01	+04	42.6711	−18	00
4512.91	44.2482	−01	−02	44.2457	−07	−02	44.1087	−12	−03	44.1165	−28	−02
4555.66	42.3886	+03	+06	42.3837	−08	+06	45.9699	−10	+02	45.9768	−27	−05
4590.12	40.9548	−14	−09	40.9510	−23	−09	47.4009	−20	−09	47.4084	−41	−06
4639.77	39.0119	+01	+04	39.0094	−06	+04	49.3436	−04	+02	49.3540	−32	00
4682.09	*37.4430*	+01	00	*37.4420*	−01	00	*50.9117*	−01	00	*50.9199*	−24	−14
4742.98	35.3230	+08	−03	35.3191	−03	−03	53.0382	−12	−20	53.0426	−25	−01
4805.44	33.3008	+22	+04	33.2981	+14	+04	55.0519	+28	+15	55.0590	+05	−12
4856.20	31.7540	+18	−02	31.7519	+11	−02	56.6023	+12	00	56.6093	−12	−04
4900.09	30.4842	+15	−03	30.4804	+02	−03	57.8747	00	−06	57.8807	−22	−08
4981.91	*28.2675*	+04	00	*28.2652*	−05	00	*60.0881*	−01	+06	*60.0944*	−25	−01
1st Constants S_0	−22.5504			−22.5504			110.8605			110.8605		
1st Constants c	99611.386			996113.86			−99448.140			−99448.140		
1st Constants λ_0	3021.70			3021.70			3023.21			3023.21		
2d Constants S_0	−22.5504			−22.5731			110.8586			110.8520		
2d Constants c	99611.386			99682.675			−99473.010			−99440.955		
2d Constants λ_0	3021.70			3021.00			3022.63			3022.78		

Reduction to Sun:		t.m.
	λ 4400	−0.12
	λ 5000	−0.13

PLATE G 259. 19 *PISCIUM*

Yellow-Green Region

WAVE-LENGTH *Fe*	RED RIGHT λ5329 to 5730			RED RIGHT λ5170 to 5327			RED LEFT		
	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2
t.m.									
5169.19	....	....	....	....	....	....	47.2418	+60	....
5227.30	*41.0882*	00	00	*41.0816*	00	00	*48.6097*	00	00
5233.12	40.9560	−01	−10	40.9496	−03	−10	48.7458	−21	−10
5269.72	40.1457	−07	00	40.1409	+01	00	49.5553	−20	00
5328.24	38.9050	−09	−01	38.8967	−17	−01	50.7950	−15	−01
5371.70	*38.0262*	00	00	*38.0198*	00	00	*51.6730*	00	00
5447.13	36.5805	+36	00	36.5731	+32	00	53.1236	+15	00
5495.88	35.6819	−06	−06	35.6761	−03	−06	54.0168	+07	−06
5586.99	34.1037	−39	−06	34.0973	−39	−06	55.5918	+05	−06
5615.80	33.6317	−27	+06	33.6260	−23	+06	56.0654	+12	+06
5710.75	*32.1467*	00	+27	*32.1404*	00	+27	*57.5588*	00	+27
1st Constants S_0	−7.9827			−7.9983			97.8653		
c	106470.150			106517.970			−107251.499		
λ_0	3057.58			3057.00			3049.85		
2d Constants	−7.9806			−8.0029			97.8716		
	106462.010			106543.200			−107326.399		
	3057.01			3056.08			3048.48		

Reduction to Sun: λ5200 −0.51
λ5800 −0.57

PLATE G 269. 19 *PISCIUM* — PLATE G 293. 19 *PISCIUM* — PLATE G 357. 19 *PISCIUM*

Yellow-Green Region

WAVE-LENGTH *Fe*	G 269 RED RIGHT			G 269 RED LEFT			G 293 RED RIGHT			G 293 RED LEFT		
	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2
t.m.	mm.			mm.			mm.			mm.		
5227.30	*43.9940*	00	−10	*41.7002*	00	−10	*42.9954*	00	+01	*45.1292*	00	−01
5233.12	43.8554	+09	+08	41.8357	+20	+08	42.8547	−01	−11	45.2760	−27	−11
5269.72	42.9853	00	+10	42.7044	+07	+10	41.9897	+07	+04	46.1398	−18	−01
5328.24	41.6500	−28	07	44.0376	−23	07	40.6623	+09	+05	47.4674	−23	−05
5371.70	*40.7129*	00	+04	*44.9744*	00	+04	*39.7178*	00	00	*48.4047*	00	00
5447.13	39.1652	+37	00	46.5299	−07	00	38.1677	+22	−01	49.9612	−10	−01
5495.88	38.2040	03	−17	47.4859	−19	−17	37.2116	+09		50.9120	+05	+05
5586.99	36.5215	−03	+06	49.1694	−15	+06	35.5195	−40	−13	52.6015	−23	−13
5615.80	36.0086	−38	−07	49.6773	−16	−07	35.0155	−22	+06	53.1090	−21	−06
5710.75	*34.4233*	00	+35	*51.2707*	00	+35	*33.4254*	00	+35	*54.7013*	00	+35
1st Constants S_0	−8.1361			94.5758			−9.4841			97.9301		
c	112070.841			−115677.489			113758.306			−115281.115		
λ_0	3077.47			3039.76			3059.63			3043.98		
2d Constants S_0							−9.4820			97.9375		
c							113766.597			115334.071		
λ_0							3059.34			3043.15		

Reduction to Sun (G 269): λ5200 −0.49; λ5800 −0.55 (t.m.)
Reduction to Sun (G 293): λ5200 −0.40; λ5800 −0.45 (t.m.)

WAVE-LENGTH *Ti*	G 357 RED RIGHT			G 357 RED LEFT		
	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2
t.m.	mm.			mm.		
5173.92	36.4756	−01	+04	48.0762	00	+04
5210.55	*35.5891*	00	00	*48.9622*	+01	00
5283.63	33.9151	+23	00	50.6387	+21	00
5336.97	32.7521	+04	−04	51.7984	+20	−04
5381.20	31.8350	+21	00	52.7175	+29	00
5418.98	31.0741	+14	+02	53.4797	+16	+02
5481.65	*29.8637*	−01	−03	*54.6903*	00	−02
5565.70	28.3422	+21	−03	56.2132	+12	−03
5644.36	*27.0004*	−01	+02	*57.5528*	00	+02
5739.69	25.4805	−20	−10	59.0691	−01	+09
1st Constants S_0	−15.8800			100.2952		
c	111464.870			−110799.850		
λ_0	3044.93			3052.09		
2d Constants S_0	−15.8947			100.3095		
c	111510.045			−110842.820		
λ_0	3044.24			3051.34		

Reduction to Sun: λ5200 −0.52; λ5800 −0.58 (t.m.)

280 *SCHJELLERUP*

Blue Region

Plate G 346				Plate G 367			
Mean Scale Reading	Wave-Length *Ti*	Δ 1	Δ 2	Mean Scale Reading	Wave-Length *Ti*	Δ 1	Δ 2
mm.	t.m.			mm.	t.m.		
49.3729	4443.7	+60	+60	*63.2423*	*4399.92*	00	00
49.8135	*4457.59*	00	−02	62.3717	4427.28	−03	+06
51.4204	4512.88	−02	+05	61.4266	4457.59	−53	−35
51.5627	4518.18	+18	+25	60.7309	4481.41	−32	−10
52.5929	4555.64	−33	−20	59.8395	4512.88	−25	00
53.4724	4590.11	+20	+34	59.6911	4518.18	−31	−06
54.1599	4617.41	−28	−16	59.5639	4522.97	−14	+11
55.0952	4656.60	−06	−01	58.6853	4555.64	−20	+04
55.6826	*4682.08*	00	+05	57.7949	4590.11	−36	−16
57.3454	4758.30	+36	−05	57.1238	4617.41	−22	−06
58.2813	4805.56	+52	+25	56.1976	4656.60	−08	−01
58.9789	4841.00	−15	−41	*55.6183*	*4682.08*	00	00
61.4564	*4981.91*	00	+03	54.2993	4742.94	−01	−12
....	....	....	....	53.5457	4780.18	+43	+27
....	....	....	....	52.0805	4856.18	+19	+01
....	....	....	....	*49.9083*	*4981.91*	00	00
S_0	94.0103				18.0710		
c	−64792.977				62770.074		
λ_0	2991.58				3010.32		
Reduction to Sun:			t.m.		t.m.		
	λ 4400		+0.03		−0.24		
	λ 5000		+0.04		−0.28		

280 *SCHJELLERUP*

Yellow-Green Region

Plate G 366				Plate G 370			
Mean Scale Reading	Wave-Length *Ti*	Δ 1	Δ 2	Mean Scale Reading	Wave-Length *Ti*	Δ 1	Δ 2
mm.	t.m.			mm.	t.m.		
40.9966	*5173.92*	00	+06	*48.8976*	*5173.92*	00	00
41.8908	5210.49	−25	−07	49.371	5193.14	+02	+18
43.8858	5297.21	−46	−29	49.7986	5210.49	−34	−11
44.7375	5336.96	+02	+07	50.1572	5226.70	+82	+109
45.6630	*5381.20*	00	−07	*52.6575*	*5336.97*	00	+02
45.9835	5396.71	−21	−30	53.5845	5381.20	+09	−04
46.2404	5409.81	+12	00	54.3470	5418.98	+27	+06
46.4255	5418.98	+02	−11	57.1059	5565.70	+11	−02
47.7924	5490.36	+43	+25	*58.4564*	*5644.36*	00	00
49.1699	5565.70	+05	−06	....	....	....	....
50.5148	*5644.36*	00	+02	....	....	....	....
S_0	93.5694				101.4441		
c	−111874.379				−111170.513		
λ_0	3045.93				3058.26		
Reduction to Sun:			t.m.		t.m.		
	λ 5200		−0.28		−0.29		
	λ 5800		−0.32		−0.33		

318 *BIRMINGHAM*

Blue Region

Plate G 276				Plate G 393			
Mean Scale Reading	Wave-Length *Fe*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
64.4229	4383.72	+08	+02	*53.2009*	*4338.05*	00	+03
63.2501	*4401.93*	00	00	51 9209	4367.81	−19	−02
62.6931	4415.29	+01	+03	56.6851	4399.92	−26	−01
59.5733	4476.19	−13	00	58.1195	4427.27	−24	+06
58.6767	4494.74	−15	00	59.6501	4457.59	−31	+02
57.0916	4528.80	−12	00	62.5149	4518.20	−29	−02
56.1596	4549 64	−06	00	64.1621	4555.66	−07	+07
54.6749	*4584.02*	00	−02	*65.6159*	*4590.12*	00	+03
51.5566	4661.67	+19	−02	66.7210	4617.41	−01	−05
49.9257	4705.13	−07	−27	69.1905	4682.09	+20	00
47.0665	4788.14	+28	+05	71.8860	4758.87	+36	+02
44.4345	4871.87	+26	+10	73.4022	4805.44	+60	+23
43.8522	4891.37	+13	00	74.5215	4841.00	+34	00
41.9707	*4957.67*	00	−03	75 8467	4885.25	+27	00
....	....	....	....	*78.5343*	*4981.91*	00	00
S_0	10.1483				129.8943		
c	99367.483				−100110.616		
λ_0	3051.12				3032.72		
		t.m.			t.m.		
Reduction to Sun:	λ 4400	+0 05			−0 24		
	λ 5000	+0.05			−0.27		

318 *BIRMINGHAM*

Yellow-Green Region

Plate G 253				Plate G 284				Plate G 379			
Mean Scale Reading	Wave-Length *Fe*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Fe*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.			mm.	t.m.		
57.2442	5169.16	+76	+67	55.0796	5169.16	+32	+13	*52.1792*	*5336.97*	00	00
58.6969	*5227.30*	00	00	*56.5509*	*5227.30*	00	−09	53.1100	5381.20	+14	+14
59.6921	5269.72	00	−08	57.5747	5269.72	−22	−06	53.8872	5418.98	−20	−20
61.0101	5328.24	−17	−05	58.9138	5328.24	−27	−11	*55.2737*	*5490.36*	00	00
61.9368	*5371.70*	00	−08	*59.8623*	*5371.70*	00	00	56.6576	5565.70	−05	−05
63.4698	5447.13	+01	−01	61.4332	5447.13	+18	−05	57 2398	5598. ±	....	....
66.0718	5586.99	−05	−09	64.0932	5586.99	+06	−09	*58.0153*	*5644.36*	00	00
66.5719	*5615.80*	00	−01	*64.6062*	*5615.80*	00	−01	....	....	....	....
68.1374	5710.75	+26	−33	66.2106	5710.75	+11	−13	....	....	....	....
S_0	98.4298				−8.8018				101.8269		
c	−109164.979				111732.492				−114566.029		
λ_0	3093.30				3087.52				3029.39		
		t.m.			t.m.				t.m.		
Reduction to Sun:	λ 5200	+0.16			+0.03				0 00		
	λ 5800	+0.17			+0.03				0.00		

74 *SCHJELLERUP*

Blue Region

PLATE G 383				PLATE G 391			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
59.7101	*4367.81*	00	−12	*63.7228*	*4338.05*	00	+02
58.6411	4387.01	−05	−11	62.0096	4367.81	−10	−03
56.5137	4427.27	+15	+15	60.9454	4387.01	−13	−04
54.9766	4457.59	00	+04	58.8166	4427.27	−13	−02
53.4843	4488.98	+32	+38	57.2945	4457.59	−08	+02
52.1098	4518.20	−02	+03	55.8020	4488.98	−36	+43
50.4506	4555.66	−11	−10	54.6765	4512.88	−03	+01
49.0041	*4590.12*	00	−04	52.7859	4555.66	+05	+04
47.9038	4617.41	+09	00	*51.3311*	*4590.12*	00	−08
45.4380	4682.09	+15	+02	50.2342	4617.41	+13	+01
42.7401	4758.87	−22	−22	49.3627	4639.81	+35	+19
41.2337	*4805.44*	00	−10	47.7783	4682.09	+57	+35
39.6574	4856.20	−53	−37	45.0831	4758.91	+50	+24
36.1047	4981.91	−24	00	43.5719	4805.44	+77	+51
....	....	....	....	41.9998	4856.20	+54	+32
....	....	....	....	*38.4550*	*4981.91*	00	−06
S_0	−14.0069				−12.5623		
c	96452.828				99163.762		
λ_0	3059.39				3038.14		
		t.m.			t.m.		
Reduction to Sun:	λ 4400	−0.27			−0.41		
	λ 5000	−0.30			−0.47		

74 *SCHJELLERUP*

Yellow-Green Region

PLATE G 373				PLATE G 386			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
49.4201	*5173.92*	00	+05	46.2325	5129.32	+23	−23
48.9478	5193.15	−04	+03	*45.1015*	*5173.92*	00	−07
48.5252	5210.55	−17	−09	44.2076	5210.55	−18	−06
46.8421	5283.63	+15	+25	42.5254	5283.63	+06	+20
45.6696	5336.96	−16	−06	41.3588	5336.96	−06	+05
44.7454	5381.20	−06	+02	40.4318	5381.20	−14	−06
43.9827	*5418.98*	00	+05	*39.6717*	*5418.98*	00	+05
42.7605	5481.64	−38	−36	38.4555	5481.64	−14	−12
41.2329	5565.70	−56	−55	38.0363	5504.10	−10	−08
40.6544	5598.52	....	....	36.9235	5565.70	−07	−05
39.8877	*5644.36*	00	+03	*35.5795*	*5644.57*	00	+04
38.3625	5739.69	+12	+21	34.5041	5710.75	−10	−03
S_0	−3.2991				−7641.6		
c	112342.502				112652.526		
λ_0	3042.96				3038.56		
		t.m.			t.m.		
Reduction to Sun:	λ 5200	−0.11			−0.41		
	λ 5800	−0.13			−0.46		

78 *SCHJELLERUP*

Blue Region

Plate G 344				Plate G 392			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
63.1672	*4367.81*	00	+05	54.8138	4367.81	+16	+06
62.1143	4387.00	−16	−05	*53.7495*	*4387.00*	00	−02
60.8363	4411.24	−18	−01	52.4548	4411.24	−09	−04
58.5141	4457.59	−22	00	50.0992	4457.59	−29	−12
55.9369	4512.88	−22	+02	47.4950	4512.88	−23	+01
54.0798	4555.64	−04	+10	45.6095	4555.64	−19	+04
52.6517	4590.11	−03	+02	44.1637	4590.11	−18	+01
51.5655	*4617.41*	00	−04	43.0637	4617.41	−15	00
49.1406	4682.08	+19	−03	*40.6050*	*4682.09*	00	00
47.0254	4742.94	+36	+02	38.4597	4742.94	+12	00
43.9084	4841.00	+35	+01	36.4094	4805.44	+28	+09
42.1881	4900.10	+34	+09	35.3002	4841.00	+18	−04
39.9713	*4981.91*	00	−03	33.9833	4885.25	+21	+02
....	....	....	....	*31.3066*	*4981.91*	00	00
S_0	−10.3146				−20.1282		
c	97825.631				100724.798		
λ_0	3036.52				3023.61		
Reduction to Sun:			t.m.		t.m.		
	λ 4400		−0.41		−0.42		
	λ 5000		−0.47		−0.47		

78 *SCHJELLERUP*

Yellow-Green Region

Plate G 300				Plate G 384			
Mean Scale Reading	Wave-Length *Fe*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
48.6220	5169.16	+80	+80	48.7537	5129.32	−01	−01
47.1559	*5227.30*	00	+08	*47.6129*	*5173.92*	00	+08
47.0039	5233.12	−48	−22	46.7019	5210.55	−37	−24
46.1419	5269.72	−38	00	43.8175	5336.96	−15	−08
44.8091	5328.24	−46	−01	*42.8835*	*5381.20*	00	+02
43.8752	*5371.70*	00	+26	42.1128	5418.98	+10	+07
42.3283	5447.13	+56	+41	40.4598	5504.10	+12	+04
39.6709	5586.99	+01	−25	39.3302	5565.70	−05	−15
39.1611	*5615.87*	00	−24	37.9753	5644.37	+31	+22
37.5737	5710.75	+91	+78	36.4263	5739.69	−11	−17
....	....	....	....	*34.2046*	*5890.19*	00	+04
....	....	....	....	34.1190	5896.16	−16	−09
S_0	−6.1511				−5.4517		
c	117379.147				112441.141		
λ_0	3025.37				3055.48		
Reduction to Sun:			t.m.		t.m.		
	λ 5200		−0.47		−0.35		
	λ 5800		−0.52		−0.39		

132 *SCHJELLERUP*
Blue Region

A 328				G 309				G 368			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Fe*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.			mm.	t.m.		
31.5024	4395.17	−02	−03	*62.4163*	*4404.93*	00	00	*56.7597*	*4387.01*	00	+03
31.9008	*4399.92*	00	+01	60.2114	4447.89	−48	+63	54.6542	4427.27	−14	+03
34.1584	4427.28	−07	+01	59.2437	4466.73	−17	+03	53.1443	4457.59	−29	−03
35.4942	4443.97	−13	−01	57.8957	4494.74	−22	+03	52.0070	4481.44	−27	+03
35.9139	4449.32	−12	+01	57.2672	4508.38	−05	+21	50.5589	4512.88	−32	00
36.5603	4457.59	−17	−03	56.3247	4528.79	−30	−03	48.6922	4555.66	−27	+02
38.3718	4481.41	−17	+01	55.4063	4549.64	−15	+10	47.2555	4590.11	−37	−14
39.8503	4501.43	−10	00	53.9336	4584.02	−18	+02	45.3119	4639.83	−03	+05
40.6756	4512.88	−17	+02	*50.8472*	*4661.67*	00	00	*43.7368*	*4682.09*	00	00
41.7110	4527.48	−15	+03	49.2341	4705.54	+22	+06	41.6096	4742.98	+15	00
42.9227	4544.83	−24	−08	46.3933	4788.37	+21	−04	39.5773	4805.44	+28	−01
43.449	4552.62	−15	00	43.7829	4871.90	+01	−13	38.0231	4856.20	+24	−01
43.6524	4555.64	−13	+01	43.2143	4891.67	+47	+37	36.7454	4900.09	+12	+03
44.2083	4563.94	−08	+05	42.2717	4924.12	00	−04	*34.5165*	*4981.91*	00	−03
45.9286	4590.11	−01	+06	*41.3449*	*4957.65*	00	+03	......	......	....	....
47.6681	4617.41	−03	−03	......	......	....	....	......	......	....	....
48.0299	*4623.24*	00	−02	......	......	....	....	......	......	....	....
48.4157	4629.47	00	−05	......	......	....	....	......	......	....	....
50.0564	4656.60	+07	−05	......	......	....	....	......	......	....	....
50.7129	4667.76	+14	−01	......	......	....	....	......	......	....	....
51.5433	4682.08	+23	+05	......	......	....	....	......	......	....	....
52.5096	4698.94	+21	00	......	......	....	....	......	......	....	....
54.9363	4742.94	+25	−02	......	......	....	....	......	......	....	....
55.8169	4759.44	+23	−06	......	......	....	....	......	......	....	....
59.9223	4841.00	+36	+07	......	......	....	....	......	......	....	....
62.0044	4885.25	+32	+08	......	......	....	....	......	......	....	....
66.2345	*4981.91*	00	00	......	......	....	....	......	......	....	....
67.5660	5014.40	−16	−04	......	......	....	....	......	......	....	....
S_0	147.4070			−10.8653				−16.6050			
c	−158930.815			100360.323				100308.460			
λ_0	3023.97			3035.41				3019.75			
Reduction to Sun:			t.m.	t.m.				t.m.			
	λ 4400		+0.09	−0.12				−0.38			
	λ 5000		+0.11	−0.14				−0.43			

132 *SCHJELLERUP*
Yellow-Green Region

WAVE-LENGTH *Fe*	PLATE G 299			PLATE G 301		
	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2
t.m.	mm.			mm.		
5169.19	....	....	....	47.1218	+12	−03
5227.30	*45.0723*	00	+04	*45.6560*	00	+07
5233.12	44.9302	−10	−04	45.5089	−26	−16
5269.72	44.0654	−28	−09	44.6418	−23	−03
5328.24	42.7445	−29	00	43.3136	−14	00
5371.70	*41.8117*	00	+32	*42.3719*	00	+04
5447.13	40.2555	−23	+07	40.8215	+42	+38
5586.99	37.6158	−28	−16	38.1675	+03	+01
5615.80	*37.1108*	00	+06	*37.6577*	00	+01
5710.75	35.5259	+94	+70	36.0667	+61	+72
S_0	−8.9628			−7.3702		
c	121504.394			115975.198		
λ_0	2978.68			3040.17		
	t.m.			t.m.		
Red. λ 5200	0.00			−0.01		
to Sun: λ 5800	0.00			−0.01		

115 *SCHJELLERUP*

Blue Region

Plate G 363				Plate G 382			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
51.2059	*4457.59*	00	−06	*55.9916*	*4387.00*	00	+04
49.3290	4522.97	+01	+05	54.8351	4421 92	−26	−10
48.4488	4555.64	−05	+01	53.7213	4457.59	−29	−07
47.5625	4590.11	+01	+07	52.1040	4512 88	−12	+09
46.8846	4617.41	−05	−01	51.9529	4518.18	−19	+01
45.3711	*4682.08*	00	−04	51.8199	4522.97	−16	+03
44.9979	4698.94	+13	+06	50.9310	4555.64	+14	+24
44.0499	4742.94	+07	−07	50.0328	4590.11	−09	−12
43.7169	4759.07	+18	+01	*49.3511*	*4617.41*	00	−16
43.2898	4779.98	+10	−09	47.830	4682.08	+41	+05
42.7865	4805.56	+30	+07	46.4976	4742.94	+51	+11
42.1030	4841 00	+08	−12	46.1608	4758.87	+37	−02
41.8180	4856.18	−01	−20	45.2229	4805.56	+67	+33
41.2918	4885.25	+15	00	44.529	4841.00	+16	−08
39.6410	*4981.91*	00	00	44.245	4856.18	+20	00
				42.0545	*4981.91*	00	+02
S_0	7.5171				10.3552		
c	63628.789				61749.228		
λ_0	3001.18				3033.93		
Reduction to Sun:	λ 4400	t.m. +0.25			t.m. −0.01		
	λ 5000	+0.29			−0.01		

115 *SCHJELLERUP*

Yellow-Green Region

Plate G 365				Plate G 374			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
45.5753	*5173.94*	00	+08	*46.4304*	*5173.94*	00	+01
45 0954	5193.15	−44	−32	45.9616	5193.15	+06	+12
44.6801	5210.55	−34	−20	45.5358	5210.55	−24	−15
41.8458	5336.96	+04	+08	42.688	5336.96	−09	+01
40.9233	*5381.20*	00	−12	*41.7645*	*5381.20*	00	+02
40.4691	5419.00	+31	+12	41.0031	5419.00	+10	+04
38.5433	5504.10	+28	+03	39.6318	5409.90	−05	−20
37 4318	5565.70	+23	+04	38.2585	5565.70	+21	+04
36.0934	*5644.37*	00	−06	36.9095	*5644.37*	00	−07
32.711	5866.69	−61	−45	....	....	....	....
S_0	−6.4285				−6.3081		
c	109710.332				112617.276		
λ_0	3061 28				3038 55		
Reduction to Sun :	λ 5200	t.m. +0.29			+0.20		
	λ 5800	+0.32			+0.22		

152 *SCHJELLERUP*—Blue Region

Plate G 316				Plate G 394			
Mean Scale Reading	Wave-Length *Fe*	Δ_1	Δ_2	Scale Mean Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
58.4979	*4404.93*	00	00	*62.2942*	*4387.01*	00	00
53.9627	4494.74	−28	+02	60.1744	4427.27	−04	+05
53.3353	4508.38	−05	+26	58 1132	4468.66	−17	+02
52.3887	4528.79	−34	−05	57.1631	4488.86	+04	+25
51.4690	4549.64	−18	+08	56.0399	4512.88	−25	−02
49.9958	4584.02	−15	+04	54.1548	4555.66	−21	+01
46.9014	*4661.67*	00	00	52.7090	4590.12	−20	−02
45.2818	4705.54	+12	00	50.7415	4639.77	+02	+09
42.4443	4788.37	+33	+01	*49.1495*	*4682.09*	00	−02
39.8347	4871.90	+30	00	47.0010	4742.98	+14	−01
38.3177	4924.12	+18	+01	44.9514	4805.44	+35	+14
37.3848	*4957.65*	00	−02	43.3770	4856.20	+17	−04
....	....	....	....	42.0906	4900.09	+23	+06
....	....	....	....	*39.8372*	*4981.91*	00	−02
S_0	−14.7723				−11.8813		
c	100044.671				101624.571		
λ^0	3039.51				3016.95		
		t.m.			t.m.		
Reduction to Sun:	λ4400	−0.13			−0.15		
	λ5000	−0.15			−0.17		

152 *SCHJELLERUP*—Blue Region

Plate A 313				Plate A 319			
Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2	Mean Scale Reading	Wave-Length *Ti*	Δ_1	Δ_2
mm.	t.m.			mm.	t.m.		
37.5957	4417.88	+06	+02	*34.1864*	*4400.74*	−82	00
38.3621	*4427.27*	+01	00	36.4392	4427.28	−74	+02
40.7605	4457.59	−11	−04	37.7721	4443.97	−72	00
41.6063	4468.65	−09	00	38.8382	4457.59	−72	−04
42.5699	4481.41	−13	−02	40.6509	4482.84	−76	−13
44.0444	4501.43	−13	−01	42.1245	4501.43	−58	−03
44.8692	4512.88	−12	00	43.3250	4518.20	−45	+03
45.9009	4527.48	−09	+03	43.9798	4527.48	−03	+03
47.1070	4544 83	−13	−02	45.1841	4544.83	−36	+01
47.8423	4555.66	−10	00	45.9218	4555.64	−34	00
48.4016	4563.94	−14	−04	46.4787	4563.94	−30	00
48.9422	4572.15	−05	+03	48.2013	4590.11	−23	−03
50.1159	4590.11	−04	+01	49.9321	4617.41	−08	−04
51.8489	4617.41	00	−01	*50.2910*	*4623.24*	00	00
52.2117	*4623.24*	00	−03	51.3057	4639.75	+03	−05
53.2231	4639.85	+13	+06	52.9721	4667.76	+21	00
54.2324	4656.60	+10	00	53.8034	4682.08	+28	+01
54.8889	4667.76	+15	+03	57.1887	4742.94	+45	+01
55.7234	4682.08	+14	00	58.0670	4759.44	+46	−01
59.1079	4742 94	+20	−01	60.4270	4805.44	+53	+01
59.9186	4758.30 du	+33	+11	62.1738	4841.00	+48	−03
59.9866	4759.44	+18	−04	64.2508	4885.25	+48	+04
61.0582	4780.	....	....	*68.4778*	*4981.91*	00	−01
62.3381	4805.25	+18	−05	....	....	....	....
64.0888	4841.00	+21	−01	....	....	....	....
64.8097	4856.18	+27	+05	....	....	....	....
66.1663	4885.25	+18	00	....	....	....	....
66.8361	4900.08	+27	+11	....	....	....	....
67.4510	4913.76	+22	+08	....	....	....	....
70.3827	*4981.91*	00	00	....	....	....	....
S_0	151.4543				148.7024		
c	−158811.978				−155701.597		
λ_0	3023.00				3041.09		
		t.m.			t.m.		
Reduction to Sun:	λ 4400	−0.13			+0.08		
	λ 5000	−0.15			+0.10		

152 *SCHJELLERUP*

Yellow-Green Region

WAVE-LENGTH *Fe*	PLATE G 275			PLATE G 291			PLATE G 302		
	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2	Mean Scale Reading	Δ_1	Δ_2
t.m.	mm.			mm.			mm.		
5169.19	46.8204	+63	+52	....	....	....	50.7350	+70	+53
5227.30	*45.3563*	−01	+01	*45.4829*	00	+06	*49.2711*	00	00
5233.12	45.2147	−04	00	....	....	....	49.1235	−30	−27
5269 72	44.3428	−19	00	44.4743	−22	−02	48.2586	−20	00
5328.24	43.0113	−25	−03	43.1478	−37	−12	46.9297	−19	00
5371.70	*42.0721*	−01	+10	*42.2151*	00	+07	*45.9897*	00	+07
5447.13	40.5139	00	+01	40.6580	−23	−20	44.4318	+03	−05
5586.99	37.8635	−36	−11	38 0212	−21	+11	41.7862	+06	00
5615.80	37.3562	−28	+01	37.5066	−63	−22	*41.2756*	00	−01
5710.75	*35.7619*	−01	+36	*35.9205*	00	−51	*39.6857*	+73	+84
1st Constants { S_0 / c / λ_0	−7.4490 114977 007 3049.92			−7.7545 117551.985 3019.23			−3 9509 116954 193 3029.83		
2d Constants { S_0 / c / λ_0	−7.4458 114945.901 3050.55								
Red. λ5200 / to Sun: λ5800	t.m. +0.29 +0.33			t.m. +0.22 +0.26			t.m. 0.00 0.00		

DETAILED MEASURES AND REDUCTIONS

The following tables contain the detailed measures and reductions, made by Mr. Parkhurst, of the spectra of eight fourth-type stars. The intensities of the lines were estimated on a scale of 10, but on account of variations in exposure time, etc., these numbers should be taken as only roughly approximate. The character of the line, whether dark (D) or bright (B), wide (w) or nebulous (n), is indicated in the second column. "Max." indicates the point of maximum intensity of a bright space. In the case of 19 *Piscium*, the first star measured, the red-right and red-left measures are given separately; for other stars the combined measures are given. The other details of the tables will be readily understood after reference to pp. 17–20.

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 264

1898, December 31, G.M.T. $12^h.5$. Hour angle, W $1^h.6$. Star fair; comparison fair.

Intensity	Character	Red Right: Mean Scale Reading	Red Right: Wave-Length Reduced to Sun	Red Left: Mean Scale Reading	Red Left: Wave-Length Reduced to Sun	Mean Wave-Length: Uncorrected	Mean Wave-Length: Cor. from Curve	Mean Wave-Length: Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
1	D	49.4583	4375.83	....	....	75.83	+4	4375.87
10	w D	49.0257	4384.26	36.6497	4383.92	84.09	+2	4384.11
2–3	n D	48.7164	4390.35	36.9718	4390.26	90.31	+5	4390.36
5	wn D	48.4777	4395.09	37.2100	4394.98	95.04	+1	4395.05
1	n D	48.1790	4401.07	37.5230	4401.24	01.16	0	4401.16
3	B	48.1096	4402.46	37.5892	4402.56	02.51	−1	4402.50
10	w D	47.9844	4404.99	37.7133	4405.07	05.03	−1	4405.02
2	D	47.7966	4408.80	37.8839	4408.53	08.67	−1	4408.66
4 5	nn D	47.4732	4415.40	38.2109	4415 20	15.30	−2	4415.28
1	D	47.0949	4423.21	38.6028	4423.29	23.25	−3	4423.22
1	B	46.9227	4426.80	38.7784	4426.94	26.87	−3	4426.84
2	n D	46.8768	4427.76	38.8158	4427.72	27.74	−4	4427.70
3	n D	46.7556	4430.29	38.9412	4430.34	30.32	−4	4430.28
6–7	wn D	46.4910	4435.86	39.1935	4435.65	35.76	−5	4435.71
1	D	46.3786	4438.24	39.3215	4438.36	38.30	−5	4438.25
1–2	n D	45.9572	4447.24	39.7303	4447.08	47.32	−6	4447.26
3	n B	45.8900	4448.69	39.8206	4449.03	48.86	−6	4448.80
4–5	n D	45.8238	4450.11	39.8816	4450.30	50.21	−6	4450.15
2	n D	45.5807	4455.38	40.1234	4455.58	55.48	−7	4455.41
3–4	n D	45.2650	4462.28	40.4331	4462.35	62.32	−8	4462.24
4	wn B	45.1861	4464.01	40.5143	4464.12	64.07	−8	4463.99
1	n D	45.1212	4465.44	40.5767	4465.50	65.47	−8	4465.39
1	n D	44.9537	4469.14	40.7469	4469.26	69.20	−8	4469.12
1–2	n D	44.4648	4480.06	41.2307	4480.06	80.06	−9	4479.97
2	D	44.3735	4482.06	41.3301	4482.30	82.18	−9	4482.09
3	B	44.2939	4483.92	41.3986	4483.85	83.89	−9	4483.80
2	B	44.1962	4486.13	41.5013	4486.17	86.15	−9	4486.06
1–2	D	44.1344	4487.54	41.5647	4487.84	87.69	−9	4487.60
3	B	44.0846	4488.67	41.6159	4488.78	88.73	−9	4488.64
2–3	D	44.0336	4489.83	41.6631	4489.85	89.84	−9	4489.75
6	D	43.7130	4497.18	41.9863	4497.26	97.22	−9	4497.13
2–3	D	43.5090	4501.90	42.1834	4501.81	01.86	−9	4501.77
6	n D	43.2936	4506.91	42.3992	4506.83	06.87	−9	4506.78
1	D	43.1708	4509.78	42.5209	4509.68	09.73	−9	4509.64
...	wn D	43.0210	4513.31	42.6451	4512.60	12.96	−9	4512.87
2	n B	42.8573	4517.17	42.8380	4517.15	17.16	−8	4517.08
4	D	42.8054	4518.40	42.8875	4518.32	18.36	−8	4518.28
1	D	42.7142	4520.57	42.9886	4520.72	20.65	−8	4520.57
3–4	B	42.6637	4521.77	43.0323	4521.76	21.77	−8	4521.69
5	D	42.6061	4523.14	43.0869	4523.00	23.07	−7	4523.00
6	w D	42.4210	4527.58	43.2698	4527.44	27.51	−7	4527.44
2–3	n D	42.2569	4531.53	43.4331	4531.37	31.45	−7	4531.38
3–4	D	42.0727	4535.99	43.6198	4535.89	35.94	−7	4535.87
3	B	42.0109	4537.49	43.6835	4537.44	37.47	−7	4537.40
3	B	41.9467	4539.06	43.7505	4539.07	39.07	−7	4539.00
3	D	41.8845	4540.58	43.8122	4540.58	40.58	−7	4540.51
1	D	41.7920	4542.84	....	....	42.84	−6	4542.78
2	B	41.7382	4544.16	43.9612	4544.22	44.19	−6	4544.13
3	B	41.5867	4547.89	44.1094	4547.87	47.88	−6	4547.82
5	D	41.5253	4549.41	44.1622	4549.17	49.29	−6	4549.23
10	w D	41.3521	4553.70	44.3387	4553.55	53.63	−6	4553.57
Limits	....	....	....	44.2780	4552.04	52.04	−6	4551.98
	....	....	....	44.3920	4554.87	54.87	−6	4554.81
3	D	41.0837	4560.40	44.6095	4560.31	60.36	−5	4560.31
3	n B	41.0220	4561.95	44.6776	4562.02	61.99	−5	4561.94
2–3	D	40.9601	4563.51	44.7490	4563.82	63.67	−5	4563.62
1	D	40.8795	4565.55	44.8262	4565.76	65.66	−4	4565.62
...	w D	40.6343	4571.76	45.0599	4571.69	71.73	−4	4571.69
2	n B	40.1663	4583.78	45.5262	4583.65	83.72	−2	4583.70
1	D	40.1297	4584.72	45.5658	4584.68	84.70	−2	4584.68
1	B	40.1032	4585.41	45.5976	4585.50	85.46	−2	4585.44
2	n D	40.0609	4586.51	45.6273	4586.27	86.39	−2	4586.37
1	D	39.8898	4590.96	45.8109	4591.05	91.01	−2	4590.99
2–3	n D	39.7594	4594.37	45.9398	4594.42	94.41	−2	4594.39
2	B	39.7022	4595.88	45.9924	4595.81	95.85	−2	4595.83
1	D	39.5104	4600.93	46.1851	4600.88	00.91	−1	4600.90

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 264 — *Continued*

Intensity	Character	Red Right		Red Left		Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Wave-Length Reduced to Sun	Uncorrected	Cor. from Curve	Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
10	w D	39.2826	4606.98	46.4155	4607.00	06.99	0	4606.99
2-3	n B	39.2156	4608.77	46.4797	4608.71	08.74	0	4608.74
1-2	B	39.0789	4612.43	46.6124	4612.26	12.35	0	4612 35
1	n D	39.0230	4613.93	46.6604	4613.55	13.74	0	4613.74
3	B	38.9832	4615.00	46.7142	4615.00	15.00	+1	4615.01
2	D	38.9309	4616.41	46.7644	4616.35	16.38	+1	4616.39
6	B	38.8783	4617.83	46.8188	4617.82	17.83	+1	4617.84
4	D	38.8059	4619.79	46.8866	4619.65	19.72	+1	4619.73
3	B	38.7468	4621 39	46.9497	4621.31	21.35	+2	4621.37
1	n D	38.6947	4622.81	46.9974	4622.66	22.74	+2	4622.76
4-5	n D	38.4561	4629.32	47.2366	4629.19	29 26	+2	4629.28
3	B	38.3865	4631.23	47.3098	4631.20	31.22	+3	4631.25
1	D	38.2639	4634.61	47.4331	4634.60	34.61	+3	4634.64
2	D	38.1573	4637.56	47.5330	4637.36	37.46	+3	4637.49
3	B	38.1179	4638.65	47.5759	4638.55	38.60	+3	4638.63
5-6	D	38.0556	4640.38	47.6452	4640.47	40.43	+4	4640.47
3	B	38.0055	4641.78	47.6880	4641.66	41.72	+4	4641.76
...	wn D	37.8532	4646.03	47.8299	4645.62	45 82	+4	4645.86
2-3	B	37.6106	4652.85	48.0828	4652.73	52.79	+4	4652.83
1	D	37.5764	4653.82	48 1234	4653.88	53.85	+4	4653 89
1	D	37.4837	4656.44	48.2069	4656.24	56.34	+5	4656.39
...	w B	37.3245	4660 97	48.3673	4660.80	60.89	+5	4660.94
1-2	D	37.2123	4664.18	48.4810	4664.05	64.12	+5	4664.17
2	n B	37.1721	4665.33	48.5299	4665.45	65.39	+5	4665.44
3	wn D	37.0754	4668.11	48.6189	4668.01	68.06	+5	4668.11
4	D	36.8324	4675 13	48.8631	4675.07	75.10	+6	4675.16
1	D	36.5878	4682.26	....	....	82.26	+6	4682.32
1	n D	36.3793	4688.39	....	....	88.39	+7	4688.46
1	n D	36.2891	4691.05	49.4104	4691.11	91.08	+7	4691.15
1	n D	....	....	49.5178	4694.29	94 29	+7	4694.36
3-4	n D	36.1039	4696.55	49.5915	4696.48	96.52	+7	4696.59
6	w D	35.5052	4714.58	50.1909	4714.53	14.56	+8	4714.64
1-2	n D	35.2360	4722.82	50.4498	4722.45	22.64	+8	4722.72
10	w D	34.8071	4736.11	50.8826	4735.86	35 99	+8	4736.07
Head	....	34.7613	4737.54	50.9412	4737.69	37.62	+8	4737.70
7-8	B	34.7296	4738.53	50.9701	4738.60	38.57	+8	4738.65
4-5	n D	34.5568	4743.96	51.1416	4743.99	43 98	+8	4744.06
7	B	34 4729	4746.61	....	....	46.61	+8	4746.69
1	n D	34 3734	4749.77	51 3189	4749.60	49.69	+8	4749.77
1-2	n D	34.0980	4758.55	51.5901	4758.26	58.41	+8	4758.49
1	D	33.8663	4766 01	51.8205	4765.67	65.84	+7	4765.91
1	D	33.6630	4772.61	52.0336	4772.58	72.60	+7	4772.67
1	n D	33 3151	4784.03	52 3886	4784.24	84.14	+6	4784.20
1	n D	33 1489	4789.53	52.5391	4789.22	89.38	+6	4789.44
1	n D	32.3595	4816.17	53.3197	4815.55	15.86	+4	4815.90
1-2	n D	32.1309	4824 19	53.5543	4823 62	23 91	+3	4823.94
1	n D	32.0206	4827 86	53.6702	4827.64	27.75	+3	4827.78
1	n D	31.8764	4832 87	53.8143	4832.65	32.76	+2	4832.78
1	n D	31.2362	4855.50	54 4570	4855.37	55.44	0	4855.44
1	n D	30.8755	4868.50	54 8195	4868.44	68.47	−2	4868.45
1	n D	30.5171	4881.67	55.1792	4881 60	81.61	−4	4881.60
End	....	27.5040	4999.7	....	....	99.7	−10	4999.6

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 343

1899, October 4, G.M.T. 15ʰ.5. Hour angle, E 1ʰ.3. Star good; comparison excellent.

8	w D	50.0071	4394.56	38.3322	4394.17	94.37	+18	4394.55
1	D	49.8543	4397 16	38.4965	4397.29	97.38	+18	4397.56
3	D	49.6999	4400.40	38.6522	4400.25	00.33	+18	4400.51
4	D	49.4703	4404.79	38.8807	4404.62	04.71	+17	4404.88
4	D	49.2871	4408.31	39.0533	4407.95	08 13	+17	4408.30
1	D	49.0913	4412.11	39.2609	4411.96	12.04	+16	4412.20
2	wn D	48.9511	4414.84	39.4076	4414.82	14.83	+16	4414.99
2-3	wn D	48.6688	4420.38	39.6901	4420.35	20.37	+14	4420.51

19 *PISCIUM* = 273 *SCHJELLERUP.* PLATE G 343—*Continued*

Intensity	Character	Red Right		Red Left		Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Wave-Length Reduced to Sun	Uncorrected	Cor. from Curve	Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
1–2	D	48.5498	4422.70	39.8116	4422.73	22.72	+13	4422.85
1–2	D	48.3316	4427.01	40.0362	4427.17	27.09	+12	4427.21
1–2	n D	48.1800	4430.03	40.1655	4429.74	29.89	+12	4430.01
3	n D	47.9267	4435.09	40.4406	4435.24	35.17	+10	4435.27
1	n D	47.7822	4437.99	40.5721	4437.68	37.84	+10	4437.94
2	B	47.7447	4438.75	40.6101	4438.65	38.70	+10	4438.80
2–3	n D	47.4727	4444.25	40.8899	4444.31	44.28	+ 8	4444.36
1	n D	47.3391	4446.97	41.0111	4446.78	46.88	+ 8	4446.96
2	n B	47.2673	4448.44	41.0901	4448.39	48.42	+ 7	4448.49
5	n D	47.2070	4449.67	41.1482	4449.58	49.63	+ 7	4449.70
1	D	47.0381	4453.13	41.3196	4453.09	53.11	+ 6	4453.17
3	n D	46.9446	4455.06	41.4083	4454.92	54.99	+ 6	4455.05
2	n D	46.6047	4462.11	41.7445	4461.89	62.00	+ 4	4462.04
3	w B	46.5158	4463.96	41.8452	4463.99	63.98	+ 4	4464.02
1	D	46.4568	4465.19	41.8949	4465.01	65.10	+ 3	4465.13
1–2	D	46.2890	4468.71	42.0685	4468.47	68.59	+ 3	4468.62
1	D	46.0997	4471.70	42.2541	4472.58	72.14	+ 2	4472.16
1–2	n D	45.9673	4475.51	42.3834	4475.32	75.42	+ 1	4475.43
1–2	n D	45.7601	4479.91	42.6037	4480.01	79.96	0	4479.96
3	n D	45.6485	4482.30	42.7043	4482.16	82.23	0	4482.23
2	n B	45.5985	4483.37	42.7624	4483.40	83.39	− 1	4483.38
1–2	n D	45.4012	4487.62	42.9453	4487.34	87.48	− 1	4487.47
2–3	D	45.3018	4489.76	43.0516	4489.63	89.70	− 2	4489.68
3	n D	44.9705	4496.97	43.3809	4496.79	96.88	− 3	4496.85
5	n D	44.7524	4501.75	43.6090	4501.79	01.77	− 5	4501.72
6–7	D	44.5174	4506.93	43.8266	4506.59	06.76	− 6	4506.70
1	D	44.3840	4509.89	....	....	09.89	− 6	4509.83
...	wn D	44.2512	4512.85	44.0902	4512.45	12.65	− 7	4512.58
3	D	44.0040	4518.39	44.3443	4518.14	18.27	− 7	4518.20
3	D	43.7945	4523.12	44.5553	4522.90	23.01	− 8	4522.93
4	nn D	....	....	44.7429	4527.16	27.16	− 9	4527.07
2	D	43.4324	4531.35	....	....	31.35	− 9	4531.26
9	D	43.2400	4535.80	45.0941	4535.19	35.50	−10	4535.40
3	n B	43.1721	4537.34	45.1821	4537.22	37.28	−10	4537.18
2	B	43.0953	4539.11	45.2577	4538.97	39.04	−10	4538.97
1	D	43.0385	4540.42	45.3146	4540.29	40.36	−10	4540.26
2	D	42.8291	4545.29	45.5259	4545.19	45.24	−10	4545.14
5	wn D	42.6501	4549.47	45.6961	4549.17	49.32	−11	4549.21
...	w D	42.4800	4553.50	45.8860	4553.62	53.56	−11	4553.45
3	nn D	42.1870	4560.40	46.1819	4560.63	60.52	−12	4560.40
2–3	D	42.0670	4563.30	46.2803	4562.98	63.14	−12	4563.02
1–2	n D	41.9547	4565.94	46.4000	4565.84	65.89	−12	4565.77
9	w D	41.7074	4571.88	46.6357	4571.50	71.69	−12	4571.57
3	n D	41.5659	4575.30	46.7910	4575.25	75.28	−12	4575.16
3–4	n D	41.4591	4577.90	46.8740	4577.26	77.60	−12	4577.48
1	D	41.3520	4580.51	47.0021	4580.39	80.45	−12	4580.33
1	D	41.2903	4582.01	47.0640	4581.90	81.96	−12	4581.84
1–2	D	41.1819	4584.67	47.1639	4584.35	84.51	−12	4584.39
2	n D	41.1100	4586.43	47.2458	4586.36	86.40	−12	4586.28
1	n D	40.9181	4591.16	47.4355	4591.03	91.10	−12	4590.98
2	n D	40.7915	4594.30	47.5709	4594.39	94.35	−12	4594.23
1	n D	40.6562	4597.66	47.6937	4597.44	97.55	−12	4597.43
2	n D	40.5229	4600.99	47.8234	4600.68	00.84	−12	4600.72
8	wn D	40.2880	4606.90	48.0610	4606.65	06.78	−12	4606.66
1	n D	40.1482	4610.43	48.1843	4609.77	00.10	−12	4609.98
1–2	nn D	40.0085	4613.98	48.3444	4613.84	13.91	−12	4613.79
3	B	39.9655	4615.08	48.3848	4614.87	14.98	−12	4614.86
3	D	39.9165	4616.33	48.4351	4616.15	16.24	−11	4616.13
6	B	39.8578	4617.83	48.4987	4617.77	17.80	−11	4617.69
5–6	D	39.7825	4619.76	48.5691	4619.58	19.67	−11	4619.56
4–5	B	39.7178	4621.42	48.6366	4621.31	21.37	−11	4621.26
2	n D	39.6553	4623.02	48.6937	4622.78	22.90	−11	4622.79
5	D	39.4078	4629.42	48.9408	4629.16	29.29	−11	4629.18
5	B	39.3374	4631.25	49.0095	4630.95	31.10	−11	4630.99
3	B	39.0427	4638.95	49.3118	4638.85	38.90	−10	4638.80
6	D	38.9875	4640.26	49.3564	4640.02	40.14	−10	4640.04
4	B	....	....	49.4215	4641.76	41.76	−10	4641.66
1	D	38.4620	4654.22	....	....	54.22	− 9	4654.13

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 343—*Continued*

Intensity	Character	Red Right		Red Left		Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Wave-Length Reduced to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
1	D	....	....	49.9950	4656.90	56.90	− 9	4656.81
10	D	35.5381	4736.38	....	....	36.38	0	4736.38
Head	....	35.4988	4737.54	....	....	37.54	0	4737.54
8	B	35.4654	4738.53	52.8867	4738.51	38.52	+ 1	4738.53
1	D	35.4245	4739.74	52.9286	4739.76	39.75	+ 1	4739.76
10	w D	35.2837	4743.92	53.0573	4743.58	43.75	+ 1	4743.76
6	B	35.2043	4746.29	53.1533	4746.23	46.26	+ 2	4746.28
2-3	n D	35.1009	4749.38	53.2585	4749.38	49.38	+ 2	4749.40
3	B	34.9146	4754.98	53.4435	4754.94	54.96	+ 2	4754.98
1	D	34.8816	4755.98	53.4860	4756.23	56.11	+ 3	4756.14
2	B	34.8534	4756.83	53.5053	4756.81	56.82	+ 3	4756.85
4-5	D	34.8067	4758.24	53.5524	4758.24	58.21	+ 3	4758.27
1	D	34.5459	4766.18	53.8148	4766.22	66.20	+ 4	4766.24
2	nn D	34.3475	4772.26	54.0091	4772.18	72.22	+ 4	4772.26
3	nn D	33.9685	4784.00	54.3919	4784.04	84.02	+ 5	4784.07
2	n D	33.7998	4789.28	54.5603	4789.31	89.30	+ 6	4789.36
2-3	n D	32.9754	4815.52	55.3857	4815.60	15.56	+ 7	4815.63
1-2	n D	32.6015	4827.68	55.7579	4827.71	27.70	+ 7	4827.77
2	n D	32.4702	4831.99	55.8949	4832.21	32.10	+ 7	4832.17
1	n D	32.3447	4836.13	56.0150	4836.17	36.15	+ 6	4836.21
1	n D	32.2511	4839.22	56.1065	4839.20	39.21	+ 6	4839.27
1	D	....	....	56.2309	4843.34	43.34	+ 6	4843.40
2	nn D	....	....	56.5819	4855.11	55.11	+ 6	4855.17
1	n D	....	....	56.7058	4859.31	59.31	+ 6	4859.37
3-4	n D	30.9979	4881.76	57.3555	4881.61	81.69	+ 2	4881.71
2	nn D	30.4566	4900.75	57.8980	4900.66	00.71	+ 1	4900.72
1	nn D	....	....	58.4450	4920.25	20.25	− 2	4920.23

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 259

1898, December 29, G.M.T. 11ʰ.6. Hour angle, W 0ʰ.6. Star fair; comparison good.

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Reduced to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m.
1-2	nn B	42.3913	5170.28	47.3039	− 41	70.50	70.39	+15	5170.54
10	wn D	....	....	47.3712	− 41	73.33	73.33	+15	5173.48
1	B	41.9086	5190.72	47.7853	− 41	90.90	90.81	+13	5190.94
4	D	41.8593	5192.83	47.8180	− 41	92.30	92.57	+12	5192.69
2	nn B	41.7703	5196.65	47.9262	− 41	96.94	96.80	+12	5196.92
1	B	41.6084	5203.64	48.0819	− 41	03.66	03.66	+10	5203.76
3-4	n B	41.3675	5214.12	48.3318	− 41	14.54	14.33	+ 7	5214.40
1	n D	41.3137	5216.47	48.3753	− 41	16.44	16.46	+ 7	5216.53
3-4	n B	41.2667	5218.53	48.4328	− 41	18.96	18.75	+ 7	5218.82
10	w D	41.0846	5226.55	48.5935	− 42	26.03	26.29	+ 5	5226.34
1	B	41.0258	5229.16	48.6722	− 42	29.52	29.34	+ 4	5229.38
2	D	40.9115	5234.22	48.7755	− 42	34.11	34.17	+ 2	5234.19
5	wn B	40.8582	5236.61	48.8388	− 42	36.93	36.72	+ 1	5236.73
3-4	B	40.6661	5245.22	49.0252	− 42	45.28	45.25	− 2	5245.23
5	D	40.6226	5247.18	49.0744	− 42	47.50	47.34	− 2	5247.32
1-2	n B	40.5786	5249.16	49.1177	− 42	49.45	49.31	− 3	5249.28
1-2	D	40.5278	5251.46	49.1635	− 42	51.52	51.49	− 3	5251.46
1	nn D	40.4412	5255.38	49.2633	− 42	56.05	55.72	− 5	5255.67
6	nn D	40.1159	5270.25	49.5781	− 42	70.44	70.35	− 8	5270.27
2	nn B	39.9184	5279.38	49.7770	− 42	79.63	79.51	− 8	5279.43
1-2	nn D	39.8252	5283.71	49.8722	− 42	84.05	83.88	− 9	5283.79
4	n D	39.5207	5297.98	50.1716	− 42	98.09	98.04	−10	5297.94
3	n D	39.4195	5302.76	50.2715	− 42	02.81	02.79	−10	5302.69
4	n B	39.3734	5304.95	50.3224	− 42	05.23	05.09	− 9	5305.00
2	n B	39.2044	5313.00	50.4890	− 42	13.16	13.08	− 9	5312.99
1	D	39.1691	5314.69	50.5244	− 42	14.86	14.78	− 9	5314.69

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 259—*Continued*

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncorrected	Cor. from Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m.
4	nn B	39.0968	5318.16	50.5956	−42	18.26	18.21	− 9	5318.12
1	B	39.0021	5322.72	50.6999	−43	23.28	23.00	− 8	5322.92
10	w D	38.8775	5329.05	50.8212	−43	29.14	29.10	− 7	5329.03
5–6	wn B	38.6757	5338.88	51.0327	−43	39.44	39.16	− 5	5339.11
1	D	38.6294	5341.14	51.0697	−43	41.26	41.20	− 5	5341.15
2	wn D	38.4432	5350.30	51.2497	−43	50.11	50.21	− 2	5350.19
2	n B	38.3991	5352.46	51.3054	−43	52.86	52.66	− 2	5352.64
8	wn D	38.0117	5371.82	51.6930	−43	72.21	72.02	+ 4	5372.06
6	B	37.9536	5374.75	51.7509	−43	75.13	74.94	+ 4	5374.98
1	n D	37.9101	5376.94	51.7913	−43	77.17	77.06	+ 4	5377.10
2–3	n D	37.5143	5397.13	52.1880	−43	97.39	97.26	+17	5397.43
2–3	n B	37.3952	5403.27	52.3111	−43	03.74	03.51	+19	5403.70
0–1	n D	37.3455	5405.84	52.3572	−43	06.13	05.99	+20	5406.19
2	n B	37.3077	5407.80	52.3975	−43	08.21	08.01	+22	5408.23
2–3	n D	37.2680	5409.86	52.4355	−43	10.19	10.03	+22	5410.25
2–3	n B	37.2237	5412.17	52.4764	−43	12.32	12.25	+22	5412.47
7–8	B	37.1286	5417.13	52.5694	−43	17.17	17.15	+23	5417.38
2–3	n D	37.0772	5419.83	52.6253	−43	20.10	19.97	+24	5420.21
4	B	37.0163	5423.03	52.6768	−43	22.80	22.92	+24	5423.16
3	n B	36.9261	5427.78	52.7762	−44	28.02	27.90	+25	5428.15
2	n D	36.8838	5430.01	52.8179	−44	30.23	30 12	+25	5430.37
2	B	36.8507	5431.77	52.8541	−44	32.14	31.96	+25	5432.21
5–6	B	36.5954	5445.37	53.0982	−44	45.14	45.26	+25	5445.51
4	n D	36.5472	5447.95	53.1541	−44	48.14	48.05	+25	5448.30
4	n B	36 4986	5450.56	53.2079	−44	51.03	50.80	+25	5451.05
4–5	n B	36.4389	5453.73	53.2661	−44	54.16	53.95	+24	5454.19
1	n D	36.3832	5456.79	53.3184	−44	56.99	56.89	+24	5457.13
2–3	n B	36.3477	5458.71	53.3590	−44	59.19	58.95	+24	5459.19
2	B	36.2779	5462.50	53.4243	−44	62.73	62.62	+22	5462.84
2	B	36.2277	5465.23	53.4687	−44	65.14	65.19	+22	5465.41
3	n B	36.1098	5471.67	53.5926	−44	71.91	71.79	+20	5471.99
4–5	B	35.9516	5480.37	53.7442	−44	80.23	80.30	+20	5480.50
2	D	35.9179	5482.23	53.7857	−44	82.52	82.38	+14	5482.52
2–3	B	35.6763	5495.65	54.0230	−44	95.70	95.68	+ 9	5495.77
2–3	D	35.6359	5197.91	54.0625	−44	97.91	97.91	+ 7	5497.98
1	nn D	35.5692	5501.64	54.1385	−44	02.16	01.90	+ 6	5501.96
1	D	35.4805	5506.63	54.2208	−44	06.79	06.71	+ 5	5506.76
2	n B	35.4377	5509.05	54.2629	−44	09.16	09.11	+ 4	5509.15
1–2	B	35.4032	5511.00	54.2908	−44	10.74	10.87	+ 3	5510.90
1	D	35.0960	5528.50	54.6018	−45	28.43	28.47	− 2	5528.45
2	n D	34.8999	5539.80	54.8020	−45	39.96	39.88	− 2	5539.86
1	n D	34.7605	5547.90	54.9421	−45	48.09	48.00	− 5	5547.95
1	D	34.5117	5562.48	55.1884	−45	62.52	62.50	− 8	5562.42
3	B	34.4790	5564.40	55.2197	−45	64.36	64.38	− 8	5564.30
1	D	34.4454	5566.40	55.2536	−45	66.36	66.38	− 9	5566.29
1	B	34.1990	5581.05	55.4956	−45	80.75	80.90	−10	5580.80
8	w D	34.1483	5584.09	55.5469	−45	83.81	83.95	−11	5583.84
3	B	34.1001	5586.99	55.5970	−45	86.82	86.91	−11	5586.80
5	B	33.9318	5597.15	55.7733	−45	97.45	97.30	−15	5597.15
1	D	33.7340	5609.19	55.9694	−45	09.38	09.29	−16	5609.13
1–2	B	33.6017	5617.31	56.0956	−45	17.12	17.22	−18	5617.04
2	n D	33.4768	5625.03	56.2165	−46	24.57	24.80	−20	5624.60
8	n D	33.3240	5634.53	56.3731	−46	34.29	34.42	−21	5634.21
Head	....	33.2937	5636.42	56.3994	−46	35.93	36.18	−22	5635.96
4	B	32.9891	5655.59	56.7067	−46	55.25	55.42	−24	5655.18
1	D	32.7514	5670.76	56.9552	−46	71.10	70.93	−27	5670.67
4	B	32.7059	5673.68	56.9978	−46	73.83	73.76	−27	5673.49
2	B	32.5241	5685.43	57.1765	−46	85.35	85.39	−29	5685.10
1	D	32.4993	5687.04	57.2066	−46	87.30	87.17	−29	5686.88
5	B	32.2261	5704.89	57.4762	−46	04.92	04.91	−30	5704.61
2	n B	32.1462	5710.18	57.5524	−46	09.94	10 06	−32	5709.74
6	B	32.0245	5718.25	....	...	.....	18.25	−33	5717.92
8	n B	....	....	57.7693	−47	24.33	24.33	−33	5724.00

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 269

1899, January 6, G.M.T.$12^h.3$. Hour angle, W $1^h.9$. Star excellent; comparison fair.

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncor-rected	Cor. by Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m
Head	....	45.4603	5167.99	40.2512	− 49	68.16	68.23	+ 25	5168.48
3	B	45.3811	5171.09	40.3168	− 49	71.03	71.06	+ 25	5171.31
7	D	45.3160	5173.64	40.3754	− 49	73.34	73.49	+ 24	5173.73
7	n D	45.0750	5183.14	40.6286	− 49	83.35	83.25	+ 21	5183.46
2	n B	44.9766	5187.14	40.7239	− 49	87.15	87.15	+ 21	5187.36
4	B	44.8689	5191.32	40.8267	− 49	91.26	91.29	+ 20	5191.49
3	D	44.8188	5193.32	40.8691	− 49	92.96	93.14	+ 20	5193.34
6	B	44.2930	5214.55	41.4087	− 49	14.81	14.68	+ 17	5214.85
1-2	D	44.2419	5216.63	41.4563	− 49	16.76	16.70	+ 16	5216.86
5	B	44.1930	5218.63	41.5093	− 49	18.94	18.79	+ 15	5218.94
7	D	43.9928	5226.85	41.6988	− 50	26.74	26.80	+ 13	5226.93
3-4	B	43.9293	5229.47	41.7817	− 50	30.18	29.83	+ 12	5229.95
5	D	43.8077	5234.51	41.8894	− 50	34.66	34.59	+ 10	5234.69
4	B	43.7406	5237.30	41.9542	− 50	37.36	37.33	+ 9	5237.42
4	D	43.6673	5240.38	42.0263	− 50	40.38	40.38	+ 9	5240.47
2-3	B	43.5127	5245.57	42.1574	− 50	45.88	45.73	+ 7	5245.80
7	D	43.4924	5247.69	42.2067	− 50	47.96	47.83	+ 6	5247.89
5-6	D	43.3967	5251.72	42.2991	− 50	51.86	51.79	+ 5	5251.84
1	D	43.2901	5256.20	42.4038	− 50	56.30	56.25	+ 3	5256.28
6	D	42.9589	5270.35	42.7438	− 50	70.84	70.62	− 2	5270.60
3	B	42.7353	5279.99	42.9646	− 50	80.39	80.19	− 6	5280.13
1	n D	42.6542	5283.51	43.0562	− 50	84.38	83.95	− 8	5283.87
6	D	42.3145	5298.37	43.3829	− 50	98.70	98.54	− 13	5298.41
2	D	42.2188	5302.59	43.4734	− 50	02.70	02.65	− 13	5302.52
2	B	41.9776	5313.30	43.7196	− 50	13.66	13.48	− 15	5313.33
1	n D	41.9277	5315.53	43.7670	− 50	15.79	15.66	− 15	5315.51
6	B	41.8758	5317.85	43.8262	− 50	18.44	18.15	− 15	5318.00
1-2	D	41.8223	5320.24	43.8901	− 51	21.30	20.77	− 15	5320.62
6	D	41.6267	5329.06	44.0755	− 51	29.68	29.37	− 15	5329.22
3-4	B	41.3948	5339.60	44.2982	− 51	39.83	39.72	− 13	5339.59
2	D	41.3565	5341.35	44.3428	− 51	41.87	41.61	− 11	5341.50
3	w D	41.1681	5350.01	44.5278	− 51	50.38	50.20	− 8	5350.12
2-3	B	41.1065	5352.85	44.5875	− 51	53.14	53.00	− 8	5352.92
4	D	40.8959	5362.63	44.8062	− 51	63.31	62.97	− 2	5362.95
1	D	40.8061	5366.81	44.9063	− 51	67.99	67.40	− 1	5367.39
2-3	B	40.7695	5368.53	44.9336	− 51	69.27	68.90	− 1	5368.89
9	D	40.7048	5371.57	44.9855	− 51	71.71	71.64	0	5371.64
8-9	B	40.6295	5375.11	45.0693	− 51	75.66	75.39	+ 1	5375.40
2	B	....	....	45.1858	− 51	81.17	81.17	+ 1	5381.18
4	D	40.2892	5391.26	45.4146	− 51	92.07	91.67	+ 10	5391.77
3	B	40.2182	5393.22	45.4463	− 51	93.59	93.41	+ 11	5393.52
3	D	40.1643	5397.25	45.5351	− 51	97.85	97.55	+ 12	5397.67
2	B	40.0238	5404.02	45.6695	− 51	04.33	04.18	+ 15	5404.33
1	n D	39.9786	5406.20	45.7264	− 51	07.09	06.65	+ 16	5406.81
2-3	D	39.8862	5410.68	45.8061	− 51	10.96	10.82	+ 17	5410.99
1-2	B	39.8504	5412.42	45.8455	− 51	12.87	12.65	+ 17	5412.82
6-7	B	39.7521	5417.22	45.9384	− 51	17.41	17.32	+ 17	5417.49
2-3	D	39.6920	5420.15	46.0028	− 52	20.55	20.35	+ 18	5420.53
5-6	B	39.6286	5423.26	46.0615	− 52	23.43	23.35	+ 18	5423.53
4	D	39.5843	5425.44	46.1077	− 52	25.71	25.58	+ 18	5425.76
5	B	39.5389	5427.68	46.1533	− 52	27.95	27.82	+ 18	5428.00
4	D	39.4848	5430.31	46.2075	− 52	30.63	30.49	+ 18	5430.67
3	B	39.4474	5432.19	46.2483	− 52	32.65	32.42	+ 19	5432.61
1	D	39.4041	5434.34	46.2889	− 52	34.66	34.50	+ 19	5434.69
4-5	n B	39.1864	5445.19	46.5008	− 52	45.22	45.21	+ 19	5445.40
6	D	39.1278	5448.12	46.5619	− 52	48.28	48.20	+ 18	5448.38
3	B	39.0625	5451.40	46.6228	− 52	51.34	51.37	+ 18	5451.55
3	B	39.0108	5454.00	46.6817	− 52	54.31	54.16	+ 18	5454.34
2-3	D	38.9571	5456.72	46.7369	− 52	57.10	56.91	+ 17	5457.06
1-2	B	38.9104	5459.08	46.7855	− 52	59.55	59.32	+ 17	5459.49
1	D	....	....	46.8177	− 52	61.19	61.19	+ 17	5461.36
3	B	38.8250	5463.40	46.8675	− 52	63.72	63.56	+ 16	5463.72
1	w D	38.7310	5468.20	46.9599	− 52	68.42	68.31	+ 16	5468.47
2	B	38.6466	5472.51	47.0145	− 52	72.71	72.63	+ 15	5472.78
4	D	38.6092	5474.43	47.0871	− 52	74.92	74.68	+ 14	5474.82
1	D	38.5440	5477.78	47.1499	− 52	78.15	77.97	+ 13	5478.10

19 *PISCIUM*=273 *SCHJELLERUP*. PLATE G 269—*Continued*

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncorrected	Cor. from Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m.
4	B	38.4941	5480.35	47.1969	−52	80.57	80.46	+13	5480.59
2	D	38.4410	5483.09	47.2447	−52	83.03	83.06	+13	5483.19
1–2	B	....	....	47.5016	−52	96.37	96.37	+10	5496.47
4–5	D	38.1482	5498.31	47.5434	−52	98.56	98.44	+10	5498.54
1–2	n D	38.0711	5501.37	47.6185	−52	02.49	01.93	+ 9	5502.02
0–1	D	....	....	47.7153	−52	07.58	07.58	+ 8	5507.66
1	D	37.8741	5512.73	47.8232	−52	13.27	13.00	+ 6	5513.06
1–2	D	37.6441	5524.96	48.0453	−53	25.07	25.02	+ 3	5525.05
1	n D	37.5802	5528.38	....	−53	.....	28.38	+ 3	5528.41
2–3	B	37.5105	5532.12	48.1754	−53	32.04	32.08	+ 2	5532.10
1	D	37.4711	5534.25	48.2205	−53	34.47	34.36	+ 1	5534.37
8	n D	37.3756	5539.40	48.3267	−53	40.20	39.80	− 1	5539.79
6	B	37.2942	5543.81	48.3952	−53	43.91	43.86	− 2	5543.84
1	D	37.2023	5548.81	48.4840	−53	48.73	48.77	− 2	5548.75
3	B	37.0998	5554.42	48.5945	−53	54.76	54.59	− 4	5554.55
1	D	37.0639	5556.38	48.6355	−53	57.00	56.68	− 4	5556 64
1	n D	36.9497	5562.66	48.7458	−53	63.07	62.87	− 6	5562.81
2–3	B	36.9118	5564.75	48.7787	−53	64.88	64.82	− 7	5564.75
3	D	36.8736	5566.86	48.8217	−53	67.25	67.06	− 7	5566.99
1	D	36.8023	5570.82	48.8835	−53	70.67	70.75	− 8	5570.67
1	B	....	....	48.9165	−53	72.50	72.50	− 8	5572.42
1	n D	....	....	48.9489	−53	74.30	74.30	− 9	5574.21
8–9	D	36.5648	5584.07	49.1271	−53	84 24	84.16	−11	5584.05
5–6	B	36.5066	5587.33	49.1821	−53	87.33	87.33	−12	5587.21
1	D	....	....	49.2191	−53	89.40	89.40	−12	5589.28
1	B	36.4203	5592.20	49.2823	−53	92.96	92.58	−13	5592.45
1	n D	....	....	49.3260	−53	95.43	95.43	−14	5595.29
4	B	36.3247	5597.61	49.3721	−53	98.04	97.83	−14	5597.69
1	n D	36.2836	5599.94	49.4118	−53	00.29	00.12	−15	5599.97
1–2	n D	36.1205	5609.23	49.5859	−53	10.20	09.72	−17	5609.55
0–1	D	36 0020	5616.03	49.6885	−53	16.07	16.05	−18	5615.87
2	B	35.9730	5617.70	49.7208	−53	17.93	17.82	−18	5617.64
1	n D	35.9290	5620.24	49.7598	−53	20.17	20.21	−19	5620.02
2	n D	35.8487	5624.87	49.8462	−54	25.15	25.01	−20	5624.81
2	B	35.7903	5627.26	49.9022	−54	28.39	27.83	−21	5627.62
2	B	35.7484	5630.70	49.9456	−54	30.91	30.81	−21	5630.60
10	D	35.6890	5634.16	50.0033	−54	34.26	34.21	−21	5634.00
...	Head	35.6562	5636 07	50.0416	−54	36.49	36.28	−23	5636.05
6	B	35.6326	5637.45	50.0673	−54	37.99	37.72	−23	5637.49
6	B	35.5672	5641.29	50.1241	−54	41.31	41.30	−24	5641.06
1	D	35.5218	5643.95	50.1686	−54	43.92	43.94	−25	5643.69
3	n B	35.4712	5646.93	50.2250	−54	47.23	47.08	−25	5646.83
0–1	D	35.4149	5650.25	....	−54	.....	50.25	−25	5650.00
8	B	35.3360	5654.93	50.3578	−54	55.07	55.00	−26	5654.74
1	D	35.2609	5659.39	50.4264	−54	59.13	59.28	−27	5659.01
1–2	D	35.0569	5671.68	50.6441	−54	72 11	71.90	−30	5671.60
2–3	B	35.0141	5674.16	50.6803	−54	74.28	74.22	−30	5673.92
1–2	D	34.9730	5676.63	50.7203	−54	76.69	76.66	−31	5676.35
1	B	34.9259	5679.48	50.7638	−54	79.31	79.40	−31	5679.09
1	B	34.8330	5685.10	50.8493	−54	84.47	84.79	−31	5684.48
4	wn B	34.6899	5693.82	51.0091	−54	94.17	94.00	−33	5693.67
0–1	D	34.6358	5697.13	51.0672	−54	97.72	97.43	−33	5697.10
3	B	34.4907	5706.05	51.1990	−54	05.80	05.93	−35	5705.58
2	D	34.4483	5708.66	51.2438	−54	08.55	08.61	−35	5708.26
2	B	34.4073	5711.20	51.2838	−54	11.02	11.11	−35	5710.76
1	D	34.3754	5713.18	51.3171	−54	13.07	13.13	−36	5712.77
1	B	34.3453	5715.05	51.3577	−54	15.58	15.32	−36	5714.96
2	B	34.2939	5718.24	51.3960	−54	17.96	18.10	−36	5717.74
4	B	34.1903	5724.71	51.5036	−54	24.65	24.68	−37	5724.31
3	D	34.0749	5731.94	51.6266	−54	32.34	32.14	−37	5731.77
2	n D	33.8804	5744.23	51.8313	−55	45.23	44.73	−39	5744.34
1	n B	....	....	51.8584	−55	46.95	46.95	−39	5746.56
1	n D	33.7952	5749.64	51.8955	−55	49.30	49.47	−39	5749.08
3	n B	33.6737	5757.41	52.0189	−55	57.16	57.29	−40	5756.89
2	n D	33.5835	5763.21	52.0912	−55	61.78	62.50	−40	5762.10
3	wn B	33.5161	5767.55	52.1736	−55	67.07	67.31	−41	5766.90
1	n B	33.3802	5776.36	52.3036	−55	75.46	75.91	−42	5775.49
1	n D	....	....	52.3455	−55	78.18	78.18	−42	5777.76

19 *PISCIUM*=273 *SCHJELLERUP*. PLATE G 269 *Continued*

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m.
1-2	B	33.3122	5780.79	52.3798	−55	80.40	80.60	−42	5780.18
3	n D	33.2371	5785.70	52.4564	−55	85.39	85.55	−42	5785.13
1-2	D	33.0335	5799.10	....	−55	.....	99.10	−44	5798.66
1	n D	....	....	53.0274	−55	23.13	23.13	−44	5822.69

19 *PISCIUM*=273 *SCHJELLERUP*. PLATE G 293

1899, January 27, G. M. T. 13h0. Hour angle, W 3h9. Star good; comparison good.

Intensity	Character	Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t. m.	mm.		t.m.	t.m.		t.m.
1-2	wn D	44.3276	5173.18	43.8093	−40	73.51	73.35	+13	5173.48
2	n D	44.0579	5183.83	44.0609	−40	83.46	83.65	+12	5183.77
1	n D	43.9335	5188.78	....	−40	.....	88.78	+11	5188.89
1-2	B	43.8898	5190.52	44.2470	−40	90.88	90.70	+11	5190.81
2	n D	43.8346	5192.73	44.2902	−40	92.61	92.67	+10	5192.77
2	n B	43.7226	5197.22	44.3986	−40	96.96	97.09	+10	5197.19
2	n B	43.3026	5214.24	44.8348	−40	14.66	14.45	+ 9	5214.54
1	n D	43.2445	5216.61	44.8875	−40	16.81	16.71	+ 7	5216.78
1	B	43.2021	5218.35	44.9238	−40	18.30	18.33	+ 7	5218.40
1	n D	43.0283	5225.50	....	−40	.....	25.50	+ 5	5225.55
1-2	D	42.8259	5233.88	45.3063	−40	34.11	34.00	+ 4	5234.04
1	D	42.6896	5239.56	45.4421	−40	39.78	39.67	+ 3	5239.70
1-2	B	42.5729	5244.45	45.5789	−40	45.52	44.99	+ 1	5245.00
4	D	42.5058	5247.28	45.6200	−40	47.25	47.27	0	5247.27
1	B	42.4700	5248.78	45.6770	−40	49.66	49.22	0	5249.22
3	D	42.4172	5251.01	45.7135	−40	51.20	51.11	0	5251.11
1	D	42.3108	5255.51	45.8297	−40	56.12	55.82	− 1	5255.81
7	n D	41.9689	5270.10	46.1627	−41	70.35	70.23	− 3	5270.20
2-3	n B	41.7429	5279.85	46.3930	−41	80.30	80.08	− 5	5280.03
1-2	D	41.6892	5282.19	46.4431	−41	82.48	82.34	− 5	5282.29
3	D	41.3253	5298.11	46.8156	−41	98.80	98.46	− 5	5298.41
1	n D	41.2195	5302.78	46.9097	−41	02.96	02.87	− 5	5302.82
1-2	B	41.1673	5306.09	46.9693	−41	05.60	05.85	− 5	5305.80
2	n B	40.9915	5312.92	47.1470	−41	13.52	13.22	− 5	5313.17
3	n D	40.9380	5315.31	47.1917	−41	15.66	15.49	− 5	5315.44
1	n B	40.8838	5317.74	47.2398	−41	17.68	17.71	− 5	5317.66
2	n D	40.8139	5320.88	47.3166	−41	21.13	21.00	− 5	5320.95
1	n D	....	....	47.4102	−41	25.35	25.35	− 4	5325.31
2-3	D	40.6414	5328.66	47.4889	−41	28.91	28.79	− 3	5328.76
1-2	B	40.4101	5339.18	47.7265	−41	39.73	39.46	− 1	5339.45
1	D	40.3725	5340.90	47.7637	−41	41.43	41.17	0	5341.17
3	D	40.1804	5349.73	47.9589	−41	50.41	50.07	+ 1	5350.08
2	wn B	....	....	48.0083	−41	52.69	52.69	+ 1	5352.70
2	B	39.7770	5368.49	48.3496	−41	68.59	68.54	+ 5	5368.59
9	w D	39.7130	5371.49	48.4172	−41	71.77	71.63	+ 6	5371.69
5-6	wn B	39.6435	5376.76	48.4854	−41	74.98	75.87	+ 6	5375.93
2	wn D	39.5873	5377.40	48.5423	−42	77.65	77.53	+ 7	5377.60
4	wn B	39.5398	5379.65	48.5990	−42	80.35	80.00	+ 8	5380.08
1	D	39.3157	5390.31	48.8188	−42	90.80	90.56	+ 9	5390.65
1	D	39.1702	5397.28	48.9671	−42	97.91	97.60	+10	5397.70
1-2	D	38.9884	5406.06	49.1493	−42	06.71	06.39	+10	5406.49
2-3	D	38.8985	5410.42	49.2266	−42	10.46	10.44	+11	5410.55
1-2	B	38.8655	5412.02	49.2717	−42	12.65	12.39	+11	5412.50
1	D	38.8309	5413.70	49.3012	−42	14.09	13.90	+11	5414.01
7	B	38.7718	5416.59	49.3638	−42	17.14	16.87	+11	5416.98
2	n D	38.7113	5419.55	49.4215	−42	19.97	19.76	+11	5419.87
4	n B	38.6454	5422.78	49.4905	−42	23.34	23.06	+12	5423.18
1	D	....	....	49.5231	−42	24.97	24.97	+12	5425.09
2-3	B	38.5594	5427.01	49.5875	−42	28.13	27.57	+12	5427.69
3	D	38.4954	5430.17	49.6291	−42	30.18	30.18	+12	5430.30
2	B	38.4608	5431.89	49.6715	−42	32.28	32.09	+12	5432.21
1	D	38.4253	5433.64	49.7051	−42	33.96	33.80	+12	5433.92
1	n D	38.3272	5438.52	49.8013	−42	38.87	38.70	+12	5438.82
1	n B	38.2020	5444.77	49.9298	−42	45.14	44.96	+11	5445.07
10	D	38.1115	5447.79	49.9861	−42	47.96	47.88	+11	5447.99

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 293—*Continued*

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m.
2	B	38.0855	5450.60	50.0365	−42	50.49	50.55	+10	5450.65
2-3	B	38.0313	5453.34	50.1014	−42	53.76	53.55	+10	5453.65
3-4	D	37.9668	5456.59	50.1614	−42	56.78	56.69	+10	5456.79
2	B	37.9252	5458.69	50.2067	−42	59.08	58.87	+10	5458.97
2	D	37.8887	5460.54	50.2453	−42	61.03	60.79	+10	5460.89
1-2	B	37.8473	5462.64	50.2819	−42	62.89	62.67	+10	5462.77
1	D	....	....	50.3803	−42	67.90	67.90	+9	5467.99
3	wn B	37.6671	5471.83	50.4713	−42	72.54	72.19	+8	5472.27
1-2	D	37.6181	5474.34	50.5081	−42	74.43	74.39	+8	5474.47
1	B	....	....	50.6344	−42	80.92	80.92	+7	5480.99
2	D	37.4621	5482.37	50.6697	−42	82.75	82.56	+7	5482.63
2	B	37.2032	5495.80	50.9215	−43	95.79	95.80	+5	5495.85
4-5	D	37.1634	5497.88	50.9682	−43	98.27	98.08	+5	5498.13
1	D	37.0861	5501.93	51.0444	−43	02.23	02.08	+4	5502.12
1	D	36.9948	5506.72	51.1359	−43	07.04	06.89	+3	5506.92
3	B	36.9370	5509.77	51.1910	−43	09.94	09.86	+3	5509.89
1-2	n D	36.8839	5512.58	51.2400	−43	12.53	12.56	+1	5512.57
0-1	D	36.6695	5523.98	51.4623	−43	24.35	24.17	−1	5524.16
2	B	36.5224	5531.86	....	−43	.....	31.86	−3	5531.83
1-2	D	36.4876	5533.73	....	−43	.....	33.73	−3	5533.70
10	D	36.3832	5539.37	51.7470	−43	39.64	39.51	−5	5539.46
2-3	B	36.3061	5543.54	51.8141	−43	43.27	43.41	−6	5543.35
1	D	36.2272	5547.83	51.9171	−43	48.87	48.35	−7	5548.28
1	D	36.1444	5552.35	51.9874	−43	52.71	52.53	−8	5552.45
2	B	36.1144	5553.99	52.0148	−43	54.20	54.10	−9	5554.01
1	D	36.0761	5556.09	52.0584	−43	56.59	56.34	−9	5556.25
1	B	36.0396	5558.09	52.0899	−43	58.32	58.21	−9	5558.12
1	D	35.9639	5562.25	52.1680	−43	62.60	62.43	−11	5562.32
2	B	35.9218	5564.57	52.2075	−43	64.79	64.68	−11	5564.57
1-2	D	35.8853	5566.59	52.2483	−43	67.04	66.82	−12	5566.70
1	D	35.8228	5570.08	52.3015	−43	69.98	70.03	−12	5569.91
1	B	35.7926	5571.72	52.3337	−43	71.76	71.74	−13	5571.61
1	D	35.7671	5573.14	52.3654	−43	73.52	73.33	−13	5573.20
1	D	35.7058	5576.55	52.4213	−43	76.63	76.59	−14	5576.45
1	B	35.6281	5580.89	52.4934	−43	80.65	80.77	−15	5580.62
10	D	35.5743	5583.90	52.5574	−43	84.23	84.07	−16	5583.91
4-5	B	35.5167	5587.13	52.6070	−43	87.01	87.07	−17	5586.90
1	D	35.4781	5589.30	52.6475	−43	89.29	89.30	−17	5589.13
2	B	35.4241	5592.32	52.6989	−43	92.18	92.25	−18	5592.07
1	D	35.3945	5594.01	52.7466	−43	94.87	94.44	−18	5594.26
3-4	B	35.3327	5597.51	52.7963	−43	97.68	97.60	−19	5597.41
1	D	35.2937	5599.72	52.8369	−43	99.98	99.85	−19	5599.66
1	D	35.1307	5609.00	53 0030	−43	09.44	09.22	−20	5609.02
0-1	D	35.0075	5616.06	53.1101	−44	15.56	15.81	−21	5615.60
2-3	n D	34.9350	5620.23	53.1898	−44	20.14	20.19	−22	5619.97
2	D	34.8480	5625.26	53.2680	−44	24.65	24.97	−23	5624.74
1	B	34.7991	5628.09	53.3223	−44	27.79	27.94	−23	5627.71
1-2	B	34.7494	5630.98	53.3754	−44	30.88	30.93	−23	5630.70
10	D	34.6859	5634.68	53.4411	−44	34.70	34.69	−23	5634.46
..	Head	34.6529	5636.60	53.4736	−44	36.59	36.60	−24	5636.36
3	B	34.6305	5637.91	53.4898	−44	37.53	37.72	−24	5637.48
2-3	B	34.5708	5641.41	53.5593	−44	41.60	41.51	−25	5641.26
1	D	34.5285	5643.89	53.5987	−44	43.91	43.90	−25	5643.65
1	n B	....	....	53.6574	−44	47.36	47.36	−25	5647.11
1	n D	34.4224	5650.13	53.7002	−44	49.88	50.01	−25	5649.76
1	B	34.3840	5652.40	53.7427	−44	52.38	52.39	−26	5652.13
1	B	34.3380	5655.13	53.7950	−44	55.50	55.28	−26	5655.02
1-2	D	34.2732	5658.97	53.8547	−44	59.02	59.00	−27	5658.73
3	B	34.0156	5674.37	54.1068	−44	74.06	74.22	−28	5673.94
1	n D	33.9817	5676.41	54.1516	−44	76.76	76.59	−28	5676.31
1	B	33.9293	5679.57	54.2020	−44	79.79	79.68	−29	5679.39
1	B	33.8439	5684.73	54.2866	−44	84.90	84.82	−30	5684.52
1	n D	33.7948	5687.71	54.3396	−44	88 11	87.91	−30	5687.61
3-4	B	33.6891	5694.15	54.4430	−44	94.40	94.28	−30	5693.98
1-2	D	33.6425	5696.99	54.4863	−44	97.04	97.02	−30	5696.72
3	B	33.5005	5705.71	54.6349	−44	06.15	05.93	−31	5705.62
2	n D	33.4497	5708.84	54.6791	−44	08.87	08.86	−31	5708.55
2	B	33.4126	5711.13	54.7160	−44	11.15	11.14	−31	5710.83

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 293 – *Continued*

Intensity	Character	Red Right		Red Left			Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Red. to Sun	Wave-Length Red. to Sun	Uncorrected	Cor. from Curve	Corrected
		mm.	t.m.	mm.		t.m.	t.m.		t.m.
1	D	33.3742	5713.51	54.7594	– 44	13.83	13.67	– 32	5713.35
5	w B	33.3120	5717.37	54.8116	– 44	17.07	17.22	– 32	5716.90
1	n D	33.2490	5721.27	54.8796	– 44	21.29	21.28	– 33	5720.95
2	B	33.1980	5724.47	54.9301	– 44	24.44	24.46	– 33	5724.13
3	n D	33.0843	5731.58	55.0491	– 45	31.87	31.73	– 33	5731.40
1	n D	32.8723	5744.96	55.2605	– 45	45.19	45.08	– 33	5744.75
1	n B	32.8321	5747.51	55.2967	– 45	47.48	47.50	– 35	5747.15
1	n D	32.7885	5750.28	55.3135	– 45	50.45	50.37	– 35	5750 02
2–3	wn B	32.6799	5757.22	55.4555	– 45	57.59	57.41	– 35	5757.06
1	n D	32.5897	5763.00	55.5380	– 45	62.87	62.94 .	– 35	5762.59
1-2	wn B	32.5096	5768.16	55.6138	– 45	67.75	67.96	– 36	5767.60
1	n D	32.4652	5771.03	55.6661	– 45	71.14	71.09	– 36	5770.73
1	n B	32.3870	5776.09	55.7438	– 45	76.79	76.44	– 36	5776.08
1	n D	32.3565	5778.07	55.7760	– 45	78.23	78.15	– 36	5777.79
1	n B	32.3219	5780.33	55.8012	– 45	79.87	80.10	– 37	5779.73
1	n D	32.0366	5799.02	56.0927	– 45	98.93	98.98	– 37	5798.61

19 *PISCIUM* = 273 *SCHJELLERUP*. PLATE G 357

1899, December 19, G.M.T. 12ʰ8. Hour angle, W. 1ʰ2. Star excellent; comparison excellent.

Intensity	Character	Red Right		Red Left		Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Wave-Length Reduced to Sun	Uncorrected	Cor. from Curve	Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
1	n D	36.5909	5168.82	47.9641	5168.97	68.90	–33	5168.57
2–3	n D	36.4711	5173.68	48.0796	5173.92	73.80	–32	5173.48
1	B	36.1344	5187.46	....	....	87.46	–27	5187.19
1–2	n D	36.0903	5189.28	48.4589	5189 16	89.22	–27	5188.95
4	n D	35.9849	5193.64	48.5632	5193.47	93 56	–25	5193.31
1	n B	35.8963	5197.32	48.6570	5197.36	97.34	–24	5197.10
10	n D	35.6360	5208.18	48.9230	5208.40	08.29	–20	5208.09
6	wn D	35.2121	5226.14	49.3305	5225.73	25.94	–14	5225.80
3	n D	35.0231	5234.24	49.5258	5234.08	34.16	–12	5234.04
2–3	wn B	34.9654	5236.73	49.5935	5236.99	36.86	–11	5236.75
1–2	nn D	34.8983	5239.62	49.6537	5239.67	39.65	–10	5239.55
5	D	34.7153	5247.56	49.8388	5247.61	47.59	– 6	5247.53
5–6	D	34.6308	5251.25	49.9220	5251.24	51.25	– 5	5251.20
4	D	34.1920	5270.58	50.3631	5270.67	70 63	– 1	5270.62
1	n B	33.9922	5279.50	50.5651	5279.69	79.60	0	5279.60
2	wn D	33.9076	5283.29	50.6377	5282.93	83.11	+ 1	5283.12
5	n D	33.5840	5297.94	50.9641	5297.69	97.82	+ 4	5297.86
2	n D	33.4820	5302.59	51.0712	5302.58	02.59	+ 5	5302.64
1–2	n B	33.4323	5304.87	51.1280	5305.18	05.03	+ 5	5305.08
2	n B	33.2535	5313.14	51.3014	5313.15	13.15	+ 6	5313.21
3	n D	33.2049	5315.34	51.3428	5315 07	15.21	+ 6	5315.27
3	n B	33.1548	5317.66	51.3978	5317.61	17.64	+ 8	5317.72
2	n D	33.0797	5321.14	51 4715	5321.03	21.09	+ 9	5321.18
1	n D	32.9979	5324.95	51.5611	5325.20	25.08	+10	5325.18
2	n D	32.9185	5328.66	51.6419	5328.98	28.82	+11	5328.93
1–2	D	32.7434	5336.89	51.8014	5336.66	36.78	+12	5336.90
2–3	n B	32.6976	5339.05	51.8536	5338.93	38.99	+12	5339.11
2	n D	32.6539	5341.12	51.8987	5341.06	41.09	+13	5341.22
4	n D	32.4716	5349.77	52.0750	5349.43	49.60	+13	5349.73
1	n B	32.4235	5352.07	52.1396	5352.51	52.29	+14	5352.43
1–2	n D	32.2084	5362.39	52.3518	5362.69	62.54	+15	5362.69
1	D	32 1267	5366.33	52.4321	5366.57	66.45	+16	5366.61
8	D	32.0281	5371.11	52.5245	5371 05	71.08	+17	5371.25
5	B	31.9549	5374 67	52.6028	5374.85	74.76	+17	5374.93
2	D	31.9047	5377.12	52.6501	5377.17	77.15	+17	5377.32
3	n B	31.8543	5379.58	52.7000	5379.60	79.59	+18	5379.77
1	nn D	31.6310	5390.55	52.9236	5390.58	90.57	+19	5390.76
4	D	31.4985	5397.11	53 0572	5397.20	97.16	+19	5397.35
1	D	31.3236	5405.83	53 2310	5405.86	05.85	+20	5406.05

19 *PISCIUM*=273 *SCHJELLERUP*. PLATE G 357—*Continued*

Intensity	Character	Red Right		Red Left		Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Wave-Length Reduced to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
4	D	31.2489	5409.57	53.3114	5409.88	09.73	+21	5409.94
1	D	31.1592	5414.07	53.3920	5413.93	14.00	+21	5414.21
6–7	B	31.1020	5416.96	53.4507	5416.90	16.93	+21	5417.14
2–3	n D	31.0479	5419.70	53.5050	5419.64	19.67	+22	5419.89
2–3	B	30.9895	5422.65	53.5654	5422.70	22.68	+22	5422.90
1	D	30.9545	5424.43	53.6026	5424.59	24.51	+22	5424.73
3	D	30.8475	5429.88	53.7055	5429.83	29.86	+22	5430.08
2	D	30.7724	5433.72	53.7791	5433.59	33.66	+22	5433.88
2	D	30.6796	5438.48	53.8684	5438.17	38.33	+22	5438.55
2	B	....	....	53.9894	5444.41	44.41	+22	5444.63
5–6	D	30.4977	5447.87	54.0422	5447.14	47.51	+22	5447.73
1–2	B	30.4435	5450.68	54.1060	5450.44	50.56	+23	5450.79
2	B	30.3931	5453.30	54.1616	5452.52	52.91	+23	5453.14
4	D	30.3307	5456.55	54.2207	5456.41	56.48	+23	5456.71
1	B	30.2931	5458.51	54.2603	5458.48	58.50	+23	5458.73
2	D	30.2570	5460.40	54.2961	5460.35	60.38	+23	5460.61
1–2	B	30.2112	5462.80	54.3419	5462.76	62.78	+23	5463.01
1–2	B	30.1771	5464.59	54.3765	5464.57	64.58	+23	5464.81
2	D	30.1373	5466.69	54.4163	5466.66	66.67	+23	5466.90
2	B	30.0390	5471.87	54.5152	5471.88	71.88	+23	5472.11
2	n D	29.9979	5474.04	54.5564	5474.06	74.05	+23	5474.28
2	n D	29.9280	5477.75	54.6266	5477.78	77.77	+23	5478.00
2–3	D	29.8442	5482.20	54.7100	5482.22	82.21	+23	5482.44
3	D	29.5614	5497.38	54.9963	5497.58	97.48	+23	5497.71
2	D	29.4792	5501.82	55.0732	5501.74	01.78	+23	5502.01
1	D	29.3828	5507.05	55.1692	5506.95	07.00	+23	5507.23
1–2	n D	29.2880	5512.22	55.2618	5511.99	12.11	+23	5512.34
1	n D	29.0767	5523.82	55.4749	5523.69	23.76	+23	5523.99
1–2	n D	29.0086	5527.58	55.5492	5527.79	27.69	+23	5527.92
2	n B	28.9425	5531.24	55.6192	5531.67	31.46	+22	5531.68
1	D	28.9077	5533.17	55.6468	5533.21	33.19	+22	5533.41
7	D	28.7985	5539.25	55.7660	5539.65	39.45	+22	5539.67
2	n D	28.6479	5547.69	55.9165	5548.28	47.99	+21	5548.20
1	n D	28.5716	5551.98	55.9824	5552.00	51.98	+21	5552.19
3	B	28.5389	5553.83	56.0157	5553.88	53.86	+20	5554.06
1–2	D	28.5065	5555.66	56.0508	5555.86	55.76	+20	5555.96
2	D	28.3946	5562.00	56.1618	5562.16	62.08	+20	5562.28
2	B	28.3622	5563.85	56.1950	5564.05	63.95	+20	5564.15
2	D	28.3225	5566.11	56.2297	5566.02	66.07	+20	5566.27
1	D	28.2556	5569.93	56.2996	5570.01	69.97	+20	5570.17
1	B	28.2357	5571.07	56.3232	5571.37	71.22	+19	5571.41
1	D	28.2064	5572.75	56.3553	5573.21	72.98	+19	5573.17
1	D	28.1550	5575.70	56.4049	5576.06	75.88	+19	5576.07
8	D	28.0143	5583.81	56.5377	5583.72	83.77	+18	5583.95
4	B	27.9691	5586.43	56.5891	5586.70	86.57	+18	5586.75
2	n D	27.9385	5588.20	56.6212	5588.56	88.38	+18	5588.56
1–2	B	27.8771	5591.77	56.6850	5592.27	92.02	+16	5592.18
1–2	n D	27.8519	5593.24	56.7174	5594.16	93.70	+16	5593.86
1–2	B	27.7870	5597.03	56.7644	5596.90	96.97	+16	5597.13
1	n D	27.7582	5598.71	56.8030	5599.10	98.91	+14	5599.05
3	n D	27.5787	5609.26	56.9777	5609.43	09.35	+13	5609.48
1	n D	27.4832	5614.91	57.0721	5615.02	14.97	+12	5615.09
3–4	n D	27.3989	5619.91	57.1574	5620.08	20.00	+10	5620.10
4–5	n D	27.3243	5624.36	57.2314	5624.50	24.43	+ 9	5624.52
10	D	27.1626	5634.05	57.3846	5633.65	33.85	+ 7	5633.92
....	Head	27.1260	5636.23	57.4310	5636.40	36.32	+ 7	5636.39
1	B	27.1109	5637.16	57.4475	5638.07	37.62	+ 7	5637.69
1–2	B	27.0499	5640.84	57.5064	5641.03	40.94	+ 7	5641.01
1	n D	26.9853	5644.75	57.5663	5644.66	44.71	+ 4	5644.75
1	n B	26.9614	5646.20	57.5912	5646.17	46.19	+ 4	5646.23
1	D	26.9033	5649.74	....	....	49.74	+ 3	5649.77
1	B	26.8662	5652.00	57.6893	5652.14	52.07	+ 3	5652.10
2	B	26.8165	5655.03	57.7445	5655.51	55.27	+ 2	5655.29
3	n D	26.7738	5657.64	57.7881	5658.18	57.91	+ 2	5657.93
2	D	26.5594	5670.84	57.9960	5670.99	70.92	+ 1	5670.93
3	B	26.5217	5673.18	58.0379	5673.59	73.39	− 4	5673.35
2–3	D	26.4767	5675.97	58.0800	5676.20	76.09	− 4	5676.05
1–2	B	26.4304	5678.84	58.1298	5679.30	79.07	− 5	5679.02

19 *PISCIUM*=273 *SCHJELLERUP*. PLATE G 357—*Continued*

Intensity	Character	Red Right		Red Left		Mean Wave-Length		
		Mean Scale Reading	Wave-Length Reduced to Sun	Mean Scale Reading	Wave-Length Reduced to Sun	Uncor-rected	Cor. from Curve	Corrected
		mm.	t.m.	mm.	t.m.	t.m.		t.m.
1	B	26.3504	5683.47	58.2076	5684.15	83.81	− 6	5683.75
4–5	n B	26.1981	5693.39	58.3626	5693.88	93.64	− 7	5693.57
2	n D	26.1487	5696.50	58.4069	5696.68	96.59	−10	5696.49
3	B	26.0122	5705.14	58.5441	5705.37	05.26	−13	5705.13
2–3	D	25.9681	5707.94	58.5862	5708.05	08.00	−16	5707.84
1–2	B	25.9312	5710.29	58.6267	5710.63	10.46	−16	5710.30
1–2	D	25.8981	5712.40	58.6644	5713.08	12.74	−17	5712.57
3	B	25.8323	5716.61	58.7269	5717.09	17.45	−18	5717.27
2	D	25.7591	5721.31	58.7931	5721.29	21.30	−18	5721.12
2	B	25.7211	5723.75	58.8383	5724.20	23.98	−18	5723.80
1–2	n D	....	....	58.9537	5731.65	31.65	−21	5731.44
3	n D	25.4132	5743.73	59.1507	5744.48	44.11	−26	5743.85
2–3	n D	25.1178	5763.17	59.4328	5763.07	63.12	−33	5762.79
4	n D	24.9911	5771.59	59.5667	5771.98	71.79	−35	5771.44
1	B	24.9298	5775.69	59.6340	5776.48	76.09	−35	5775.74
1	D	24.8977	5777.84	59.6633	5778.45	78.15	−37	5777.78
1	B	24.8696	5779.72	59.6891	5780.18	79.95	−40	5779.55
1–2	D	24.5942	5798.32	59.9630	5798.70	98.56	−50	5778.06
1	D	24.2375	5822.81	60.3219	5823.36	23.09	−40	5822.69

19 *PISCIUM*=273 *SCHJELLERUP*

Means of Two Plates

Plate G 264			Plate G 343			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t.m.			t.m.	t.m.		t.m.
1	D	4375.87	...	....	....	75.81	+3	4375.84
10	w D	4384.11	...	....	....	84.05	+3	4384.08
2–3	n D	4390.36	...	....	....	90.30	+3	4390.33
5	wn D	4395.05	8	w D	4394.55	94.80	+3	4394.83
...	....	....	1	D	4397.56	97.62	+3	4397.65
1	n D	4401.16	3	D	4400.51	00.84	+3	4400.87
3	B	4402.50	...	....	....	02.44	+3	4402.47
10	w D	4405.02	4	D	4401.88	04.95	+3	4404.98
2	D	4408.66	4	D	4408.30	08.48	+3	4408.51
...	....	....	1	D	4412.20	12.26	+3	4412.29
4–5	nn D	4415.28	2	wn D	4414.99	15.14	+3	4415.17
...	....	....	2–3	wn D	4420.51	20.57	+3	4420.60
1	D	4423.22	1–2	D	4422.85	23.04	+3	4423.07
1	B	4426.84	...	....	....	26.78	+3	4426.81
2	n D	4427.70	1–2	D	4427.21	27.46	+3	4427.49
3	n D	4430.28	1–2	n D	4430.01	30.15	+3	4430.18
6–7	wn D	4435.71	3	n D	4435.27	35.49	+3	4435.52
1	D	4438.25	1	n D	4437.94	38.10	+3	4438.13
...	....	....	2	B	4438.80	38.86	+3	4438.89
...	....	....	2–3	n D	4444.36	44.42	+3	4444.45
1–2	n D	4447.26	1	n D	4446.96	47.11	+3	4447.14
3	n B	4448.80	2	n B	4448.49	48.65	+3	4448.68
4–5	n D	4450.15	5	n D	4449.70	49.93	+3	4449.96
...	....	....	1	D	4453.17	53.23	+3	4453.26
2	n D	4455.41	3	n D	4455.05	55.23	+3	4455.26
3–4	n D	4462.24	2	n D	4462.04	62.11	+3	4462.17
4	wn B	4463.99	3	w B	4464.02	64.01	+3	4464.04
1	n D	4465.39	1	D	4465.13	65.26	+3	4465.29
1	n D	4469.12	1–2	D	4468.62	68.92	+3	4468.95
...	....	....	1	D	4472.16	72.22	+3	4472.25
...	....	....	1–2	n D	4475.43	75.49	+3	4475.52

19 *PISCIUM* = 273 *SCHJELLERUP—Continued*

Plate G 264			Plate G 343			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t.m.			t.m.	t.m.		t.m.
1–2	n D	4479.97	1–2	n D	4479.96	79.97	+3	4480.00
2	D	4482.09	3	n D	4482.23	82.16	+3	4482.19
3	B	4483.80	2	n B	4483.38	83.59	+3	4483.62
2	B	4486.06	...	....	....	86.00	+3	4486.03
1–2	D	4487.60	1–2	n D	4487.47	87.54	+3	4487.57
3	B	4488.64	...	....	....	88.58	+3	4488.61
2–3	D	4489.75	2–3	D	4489.68	89.72	+3	4489.75
6	D	4497.13	3	n D	4496.85	96.99	+3	4497.02
2–3	D	4501.77	5	n D	4501.72	01.75	+3	4501.78
6	n D	4506.78	6–7	D	4506.70	06.74	+3	4506.77
1	D	4509.64	1	D	4509.83	09.74	+3	4509.77
...	wn D	4512.87	...	wn D	4512.58	12.73	+3	4512.76
2	n B	4517.08	...	....	....	17.02	+3	4517.05
4	D	4518.28	3	D	4518.20	18.24	+3	4518.27
1	D	4520.57	...	....	....	20.51	+3	4520.54
3–4	B	4521.69	...	....	....	21.63	+3	4521.66
5	D	4523.00	3	D	4522.93	22.97	+3	4523.00
6	w D	4527.44	4	nn D	4527.07	27.26	+3	4527.29
2–3	n D	4531.38	2	D	4531.26	31.32	+3	4531.35
3–4	wn D	4535.87	9	wn D	4535.40	35.64	+3	4535.67
3	B	4537.40	3	n B	4537.18	37.29	+3	4537.32
3	B	4539.00	2	B	4538.94	38.97	+3	4539.00
3	D	4540.51	1	D	4540.26	40.39	+3	4540.42
1	D	4542.78	...	....	....	42.72	+3	4542.75
2	B	4544.13	...	....	....	44.07	+3	4544.10
3	n B	4547.82	...	....	....	47.76	+3	4547.79
5	wn D	4549.23	5	wn D	4549.21	49.22	+3	4549.24
10	w D	4553.57	...	w D	4553.45	53.51	+3	4553.54
Limits {		4551.98	...	....	....	51.92	+3	4552.0
		4554.81	...	....	....	54.75	+3	4554.8
3	D	4560.31	3	nn D	4560.40	60.36	+3	4560.39
3	n B	4561.94	...	....	....	61.88	+3	4561.91
2–3	D	4563.62	2–3	D	4563.02	63.32	+3	4563.35
1	D	4565.62	1–2	n D	4565.77	65.70	+3	4565.73
...	w D	4571.69	9	w D	4571.57	71.63	+3	4571.66
...	....	....	3	n D	4575.16	75.22	+3	4575.25
...	....	....	3–4	n D	4577.48	77.54	+3	4577.57
...	....	....	...	Head	4578.0	78.1	+3	4578.1
...	....	....	1	D	4580.33	80.39	+3	4580.42
...	....	....	1	D	4581.84	81.90	+3	4581.93
2	n B	4583.70	...	....	....	83.64	+3	4583.67
1	D	4584.68	1–2	D	4584.39	84.54	+3	4584.57
1	B	4585.44	...	....	....	85.38	+3	4585.41
2	n D	4586.37	2	n D	4586.28	86.34	+3	4586.37
1	D	4590.99	1	n D	4590.98	90.99	+3	4591.02
2–3	n D	4594.39	2	n D	4594.23	94.31	+3	4594.34
2	n B	4595.83	...	....	....	95.77	+3	4595.80
...	....	....	1	n D	4597.43	97.49	+3	4597.52
1	D	4600.90	2	n D	4600.72	00.81	+3	4600.84
10	w D	4606.99	8	wn D	4606.66	06.83	+3	4606.86
...	....	....	1	n D	4609.98	10.04	+3	4610.07
1–2	B	4612.35	...	....	....	12.29	+3	4612.32
1	n D	4613.74	1–2	nn D	4613.79	13.77	+3	4613.80
3	B	4615.01	3	B	4614.86	14.92	+3	4614.95
2	D	4616.39	3	D	4616.13	16.26	+3	4616.29
6	B	4617.84	6	B	4317.69	17.77	+3	4617.80
4	D	4619.73	5–6	D	4619.56	19.65	+3	4619.68
3	B	4621.37	4–5	B	4621.26	21.32	+3	4621.35
1	n D	4622.76	2	n D	4622.79	22.78	+3	4622.81
4–5	wn D	4629.28	5	D	4629.18	29.23	+3	4629.26
3	B	4631.25	5	B	4630.99	31.12	+3	4631.15
1	D	4634.64	...	....	....	34.58	+3	4634.61
2	D	4637.49	...	....	....	37.43	+3	4637.46
3	B	4638.63	3	B	4638.80	38.72	+3	4638.75
5–6	D	4640.47	6	D	4640.04	40.26	+3	4940.29
3	n B	4641.76	4	n B	4641.66	41.71	+3	4641.74
...	wn D	4645.86	...	....	....	45.80	+3	4645.83
2–3	B	4652.83	...	....	....	52.77	+3	4652.80

19 *PISCIUM* = 273 *SCHJELLERUP* — *Continued*

Plate G 264			Plate G 343			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t. m.			t. m.	t. m.		t. m.
1	D	4653.89	1	D	4654.13	54.01	+3	4654.04
1	D	4656.39	1	D	4656.81	56.60	+3	4656.63
...	w B	4660.94	...	....	....	60.88	+3	4660.91
1-2	D	4664.17	...	....	....	64.11	+3	4664.14
2	n B	4665.44	...	....	....	65.38	+3	4665.41
3	wn D	4668.11	...	....	....	68.05	+3	4668.08
4	D	4675.16	...	....	....	75.10	+3	4675.13
1	D	4682.32	...	....	....	82.26	+3	4682.29
1	n D	4688.46	...	....	....	88.40	+3	4688.43
1	n D	4691.15	...	....	....	91.09	+3	4691.12
3-4	n D	4696.59	...	....	....	96.53	+3	4696.56
...	....	....		Head	4697.1	97.2	+3	4697.2
6	wn D	4714.64	...	....	....	14.58	+3	4714.61
...	....	....		Head	4714.7	14.8	+3	4714.8
1-2	n D	4722.72	...	....	....	22.66	+3	4722.69
10	w D	4736.07	10	n D	4736.38	36.23	+3	4736.26
	Head	4737.70		Head	4737.54	37.62	+3	4737.65
7-8	B	4738.65	8	B	4738.53	38.59	+3	4738.62
...	....	....	1	D	4739.76	39.82	+3	4739.85
4-5	n D	4744.06	10	w D	4743.76	43.91	+3	4743.94
7	B	4746.69	6	B	4746.28	46.49	+3	4746.52
1	n D	4749.77	2-3	n D	4749.40	49.59	+3	4749.62
...	....	....	3	B	4754.98	55.04	+3	4755.07
...	....	....	1	D	4756.14	56.20	+3	4756.23
...	....	....	2	B	4756.85	56.91	+3	4756.94
1-2	wn D	4758.49	4-5	n D	4758.27	58.38	+3	4758.41
1	D	4765.91	1	D	4766.24	66.08	+3	4766.11
1	D	4772.67	2	nn D	4772.26	72.37	+3	4772.40
1	n D	4784.20	3	nn D	4784.07	84.14	+3	4784.17
1	n D	4789.44	2	n D	4789.36	89.40	+3	4789.43
1	n D	4815.90	2-3	n D	4815.63	15.77	+3	4815.81
1-2	n D	4823.94	...	....	....	23.88	+3	4823.91
1	n D	4827.78	1-2	n D	4827.77	27.78	+3	4827.81
1	n D	4832.78	2	n D	4832.17	32.48	+3	4832.51
...	....	....	1	n D	4836.21	36.27	+3	4836.30
...	....	....	1	n D	4839.27	39.33	+3	4839.36
...	....	....	1	D	4843.40	43.46	+3	4843.19
1	n D	4855.44	2	nn D	4855.17	55.31	+3	4855.34
...	....	....	1	n D	4859.37	59.43	+3	4859.46
1	n D	4868.45	...	....	....	68.39	+3	4868.42
1	n D	4881.60	3-4	n D	4881.71	81.66	+3	4981.69
...	....	....	2	nn D	4900.72	00.78	+3	4900.81
1-2	n D	4921.76	1	nn D	4920.23	21.00	+3	4921.03
1	n D	4924.94	...	....	....	24.88	+3	4924.91

19 *PISCIUM* = 273 *SCHJELLERUP*

Means of Four Plates

G 259			G 269			G 293			G 357			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t.m.			t.m.			t.m.			t.m.	t.m.		t.m.
...	....	....	...	Head	68.48	...	....	.....	...	....	.....	68.48	+3	5168.51
10	w D	5173.48	7	D	73.73	1-2	wn D	73.48	2-3	n D	73.48	73.54	+3	5173.57
...	....	....	7	D	83.70	1-2	n D	83.77	...	....	.....	83.74	+3	5183.77
...	....	....	2	wn B	87.36	...	....	.....	1	B	87.19	87.28	+3	5187.31
...	....	....	...	....	.....	1	n D	88.89	1-2	n D	88.95	88.92	+3	5188.95
1	B	5190.94	4	B	91.49	1-2	n B	90.81	...	....	.....	91.08	+3	5191.11
4	wn D	5192.69	3	D	93.31	2	D	92.77	4	n D	93.31	93.03	+3	5193.06

19 *PISCIUM* = 273 *SCHJELLERUP*—*Continued*

G 259			G 269			G 293			G 357			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t.m.			t.m.			t.m.			t.m.	t.m.		t.m.
2	n B	5196.92	...	....	.....	1–2	n B	97.19	1	n B	97.60	97.07	+3	5197.10
1	B	5203.76	2	n B	04.22	...	....	.....	...	....	.....	03.99	+3	5204.02
...	....	....	...	w D	08.54	...	....	.....	...	w D	08.09	08.32	+3	5208.35
3	n B	5214.40	6	B	14.85	1–2	B	14.54	...	....	.....	14.60	+3	5214.63
1	n D	5216.53	1–2	D	16.86	1	n D	16.78	...	....	.....	16.72	+3	5216.75
3–4	n B	5218.82	5	n B	18.94	1	B	18.40	...	....	.....	18.72	+3	5218.75
10	D	5226.34	7	D	26.93	1	n D	25.55	6	n D	25.80	26.16	+3	5226.19
1	n B	5229.38	3–4	B	29.95	...	....	.....	...	....	.....	29.67	+3	5229.70
2	D	5234.19	5	D	34.69	1–2	n D	34.04	3	n D	34.04	34.24	+3	5234.27
...	....	....	1	D	40.47	1	D	39.70	1–2	n D	39.55	39.91	+3	5239.94
3–4	B	5245 23	2–3	B	45.80	1–2	n B	45.00	...	....	.....	45.34	+3	5245.37
5	D	5247.32	6–7	D	47.89	3 4	n D	47.27	5	D	47.53	47.53	+3	5247.56
1–2	B	5249.28	4	B	49.83	1	n B	49.22	...	....	.....	49.44	+3	5249.47
1–2	D	5251.46	5–6	D	51.84	3	n D	51.11	5–6	D	51.20	51.41	+3	5251.44
1	nn D	5255.67	1	D	56.28	1	D	55.81	...	....	.....	55.92	+4	5255.96
6	wn D	5270.27	6	D	70.60	7	n D	70.20	4	D	70.62	70.42	+4	5270.46
2	nn B	5279.43	3	B	80.13	2–3	n B	80.03	2	n B	79.60	79.55	+4	5279.59
1	nn D	5283.79	1	D	83.87	1–2	n D	82.29	2	n D	83.12	83.13	+4	5283.17
4	n D	5297.94	6	D	98.41	3	n D	98.41	5	n D	97.86	98.15	+4	5298.19
3	n D	5302.69	2	n D	02.52	1	n D	02.82	2	n D	02.64	02.72	+4	5302.76
4	n B	5305.00	4	B	05.01	1	B	05.80	1–2	n B	05.08	05.22	+4	5305.26
2	n B	5312.99	2	n B	13.33	2	n B	13.17	2	n B	13.21	13.18	+4	5313.22
1	n D	5314.69	1	n D	15.51	3	n D	15.44	3	n D	15.27	15.23	+4	5315.27
4	nn B	5318.12	6	B	18.00	4	n B	17.66	3	n B	17.72	17.87	+4	5317.91
...	....	....	1–2	D	20.62	2	n D	20.95	2	n D	21.18	20.95	+4	5320.99
...	....	....	1	D	25.63	1	n D	25.31	1	n D	25.18	25.28	+4	5325.32
10	w D	5329.03	6	n D	29.22	2–3	n D	28.76	2	n D	28.93	28.99	+4	5329.03
...	....	....	...	....	.....	...	....	.....	1–2	n D	36.90	36.90	+4	5336.94
5–6	wn B	5339.11	3–4	B	39.59	1–2	B	39.45	2–3	n B	39.11	39.32	+4	5339.36
1	D	5341.15	2	D	41.50	4	D	41.17	2	n D	41.22	41.26	+4	5341.30
2	wn D	5350.19	3	wn D	50.12	3	D	50.08	4	n D	49.73	50.03	+4	5350.07
2	nn B	5352.64	2–3	B	52.92	2	wn B	52.70	1	n B	52.43	52.67	+4	5352.71
...	....	....	1	D	62.95	...	....	.....	1	D	62.69	62.95	+4	5362.99
...	....	....	0–1	D	67.39	2	n D	66.69	1	n D	66.61	66 90	+4	5366.94
...	....	....	2–3	B	68.89	2	B	68.59	...	....	.....	68.74	+4	5368.78
8	wn D	5372.06	9	D	71.64	9	w D	71.69	8	D	71.25	71.66	+4	5371.70
6	B	5374.98	8–9	B	75.40	5–6	n B	75.93	5	B	74.93	75.34	+4	5375.38
1	n D	5377.10	0–1	D	78.17	2	n D	77.60	2	D	77.32	77.54	+4	5377.58
...	....	....	2–3	B	79.58	4	wn B	80.08	3	n B	79.77	79.78	+4	5379.82
..	....	....	1	D	91.77	1	D	90.65	1	nn D	90.76	91.05	+4	5391.09
3	n D	5397.43	3	D	97.67	1	D	97.70	4	n D	97.35	97.54	+4	5397.58
2	n B	5403.70	2	B	04.33	...	....	.....	...	....	.....	03 90	+4	5403.94
0–1	n D	5406.19	1	n D	06.81	1–2	n D	06.49	1	n D	06.05	06 39	+4	5406.43
2–3	n D	5410.25	2	D	10.99	2–3	D	10 55	4	D	09.94	10.24	+4	5410.28
2–3	n B	5412.47	1	B	12.82	1	B	12.50	...	....	.....	12.60	+4	5412.64
...	....	....	1	D	15.01	1	D	14.01	1	n D	14.21	14.41	+4	5414.45
7–8	B	5417.38	6–7	wn B	17.49	7	wn B	16.98	6–7	n B	17.14	17.25	+4	5417.29
2–3	n D	5420.21	2–3	D	20.53	2	D	19.87	2–3	D	19.89	20.13	+4	5420.17
4	B	5423.16	5–6	B	23.53	4	n B	23.18	2–3	n B	22.90	23.19	+4	5423.23
...	....	....	1	D	25.76	1	D	25.09	1	D	24.73	25.20	+4	5425.24
3	n B	5428.15	5	B	28.00	2–3	B	27.69	...	....	.....	27.95	+4	5427.99
2	n D	5430.37	4	D	30.67	3	D	30.30	3	D	30.08	30.35	+4	5430.39
2	B	5432.21	3	B	32.61	2	B	32.21	...	....	.....	32.34	+4	5432.38
...	....	....	1	D	34.69	1	D	33.92	2	D	33 88	34.16	+4	5434.20
...	....	....	0–1	D	39.00	1	n D	38.82	2	D	38.55	38.79	+4	5438.83
5–6	B	5445.51	5	B	45.40	1	B	45.07	2	n B	44.63	45.15	+4	5445.19
4	n D	5448.30	6	D	48.38	10	D	47.99	5–6	D	47.73	48.10	+4	5448.14
4	n B	5451.05	3	B	51.55	2	B	50.65	1–2	B	50.79	51.01	+4	5451.05
4–5	n B	5454.19	3	B	54.34	2–3	B	53.65	2	B	53.14	53.81	+4	5453.85
1	n D	5457.13	2–3	D	57.06	3 4	n D	56.79	4	D	56.71	56.92	+4	5456.96
2–3	n B	5459.19	1–2	B	59.49	2	B	58.97	1	B	58.73	59.10	+4	5459.14
...	....	....	1	D	61.36	2	D	60.89	2	D	60.61	60.95	+4	5460.99
2	B	5462.81				1–2	n B	62.77	2	B	63.01	62.87	+4	5462.91
			4	B	63.72							63.72	+4	5463 76
2	B	5465.41				...	....	.....	1–2	B	64.81	65.11	+4	5465.15
...	....	....	...	w D	68.47	0–1	D	67.99	2	n D	66.90	67.79	+4	5467.83
3	n B	5471.99	2	B	72.78	3	n B	72.27	2	B	72.11	72.39	+4	5472.43
...	....	....	1	D	74.82	1–2	n D	74.47	2	n D	74.28	74.52	+4	5474.56

19 *PISCIUM*=273 *SCHJELLERUP*—*Continued*

G 259			G 269			G 293			G 357			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t.m.			t.m.			t.m.			t.m.	t.m.		t.m.
...	....	....	1	D	78.10	...	....	.....	1-2	n D	78.00	78.05	+4	5478.09
...	....	....	5	B	80.70	1	B	80.99	...	....	.....	80.85	+4	5480.89
2	D	5482.52	2	D	83.19	2	D	82.63	2-3	D	82.44	82.69	+4	5482.73
2-3	n B	5495.77	1-2	B	96.47	2	n B	95.85	...	....	.....	96.03	+4	5496.07
2-3	n D	5498.52	4-5	D	98.54	4-5	D	98.13	3	D	97.71	98.23	+4	5498.27
1	nn D	5501.96	1-2	n D	02.02	1	D	02.12	2	D	02.01	02.03	+4	5502.07
1	n D	5506.76	0-1	D	07.66	1	n D	06.92	1	D	07.23	07.14	+4	5507.18
2	n B	5509.15	4	n B	09.18	1-2	B	09.89	...	....	.....	09.17	+4	5509.51
1	n B	5510.90	...	....	.....	2-3	B	10.45	...	....	.....	10.68	+4	5510.72
...	....	....	1	D	13.06	1-2	n D	12.57	1-2	n D	12.34	12.66	+4	5512.70
...	....	....	0-1	D	25.05	1	n D	24.16	1	n D	23.99	24.40	+4	5524.44
1	D	5528.45	0-1	D	28.41	...	...	.....	1-2	D	27.92	28.20	+4	5528.24
...	....	....	2	B	32.10	2	n B	31.83	1	n B	31.68	31.92	+4	5531.96
...	....	....	1	D	34.37	1-2	D	33.70	1	D	33.41	33.83	+4	5533.87
2	n D	5539.86	8	n D	39.79	10	w D	39.46	7	n D	39.67	39.69	+4	5539.73
...	....	....	Head	....	41.75	...	....	.....	...	....	.....	41.75	+4	5541.79
...	....	....	6	B	43.84	2-3	n B	43.35	...	....	.....	43.40	+4	5543.44
1	n D	5547.95	1	D	48.75	1	n D	48.28	2	n D	48.20	48.30	+4	5548.34
...	....	....	1	D	52.50	1	n D	52.45	1	n D	52.19	52.38	+4	5552.42
...	....	....	2	B	54.55	2	B	54.01	3	B	54.06	54.25	+4	5554.29
...	....	....	1	D	56.64	1	D	56.25	1-2	D	55.96	56.28	+4	5556.32
1	n D	5562.42	1-2	n D	62.81	1	D	62.85	2	D	62.28	62.51	+4	5562.55
3	n B	5564.30	2-3	B	64.75	2	B	64.57	2	B	64.15	64.45	+4	5564.49
1	D	5566.29	2-3	D	66.99	1-2	D	66.70	2	n D	66.27	66.56	+4	5566.60
...	....	....	1	D	70.67	1	D	69.91	1	D	70.17	70.25	+4	5570.29
...	....	....	0-1	D	74.21	1	D	73.20	1	D	73.17	73.53	+4	5573.57
...	....	....	...	....	.....	1	B	74.75	...	....	.....	74.75	+4	5574.79
...	....	....	...	....	.....	1	D	76.45	1	D	76.07	76.46	+4	5576.49
8	n D	5583.84	8-9	D	84.05	10	n D	83.91	8	D	83.95	83.94	+4	5583.98
...	....	....	Head		85.76	...	....	.....	...	....	.....	85.76	+4	5585.80
3	B	5586.80	5	B	87.21	4-5	B	86.90	4	B	86.79	86.93	+4	5586.97
...	....	....	1	n D	89.28	1	n D	89.13	2	n D	88.56	89.02	+4	5589.06
...	....	....	1-2	n B	92.45	2	n B	92.07	1-2	B	92.18	92.23	+4	5592.27
...	....	....	1	n D	95.29	1	D	94.26	1-2	n D	93.86	94.47	+4	5594.51
6	n B	5597.15	4	B	97.69	3-4	B	97.40	1-2	B	97.13	97.47	+4	5597.51
...	....	....	1	n D	99.97	1	n D	99.66	1	n D	99.05	99.56	+4	5599.60
...	....	....	...	....	.....	1	B	06.36	...	....	.....	06.36	+4	5606.40
1	n D	5609.13	1-2	n D	09.55	1	n D	09.02	3	n D	09.48	09.17	+4	5609.22
...	....	....	0-1	D	15.87	0-1	D	15.60	1	n D	15.09	15.52	+4	5615.56
2	n B	5617.04	2	B	17.64	...	....	.....	...	....	.....	17.34	+4	5617.38
...	....	....	1-2	n D	20.02	2-3	n D	19.97	3-4	n D	20.10	20.03	+4	5620.07
...	....	....	...	....	.....	1	B	22.25	...	....	.....	22.25	+4	5622.29
2	n D	5624.60	2	n D	24.81	2	n D	24.74	4-5	n D	24.52	24.67	+4	5624.71
...	....	....	2	B	27.62	1	B	27.71	...	....	.....	27.66	+4	5627.70
...	....	....	2-3	B	30.60	1-2	B	30.70	...	....	.....	30.65	+4	5630.69
8	n D	5634.21	10	D	34.00	10	D	34.46	10	D	33.92	34.17	+4	5634.21
...	Head	5635.96	...	....	36.05	...	...	36.36	...	....	36.39	36.09	+4	5636.13
...	....	....	6	B	37.49	3	B	37.48	1	B	37.69	37.55	+4	5637.59
...	....	....	6	B	41.06	2-3	B	41.26	1-2	B	41.01	41.08	+4	5641.12
...	....	....	1	D	43.69	1	n D	43.65	1	n D	44.75	44.03	+4	5644.07
...	....	....	3-4	n B	46.83	1	n B	47.11	1	n B	46.23	46.71	+4	5646.75
...	....	....	0-1	D	50.00	1	n D	49.76	1	D	49.77	49.84	+4	5649.88
...	....	....	5-6	B	53.37	1	B	53.42	...	....	.....	53.40	+4	5653.44
3-4	B	5655.18	5	B	54.74	1-2	B	55.02	2	B	55.29	55.06	+4	5655.10
...	....	....	1	D	59.01	1-2	D	58.73	3	n D	57.92	58.65	+4	5658.69
4	n B	5673.49	2-3	B	73.92	3	B	73.94	3	B	73.35	73.72	+4	5673.76
1	D	5676.61	1-2	D	76.35	1-2	n D	76.31	2-3	D	76.05	76.37	+4	5676.41
...	....	....	1	B	79.09	1	n B	79.39	1-2	B	79.02	79.17	+4	5679.21
...	....	....	1	B	84.48	1	n B	84.52	1	B	83.75	84.25	+4	5684.29
1	n D	5686.88	1	D	87.12	1-2	n D	87.61	1	n D	86.66	87.07	+4	5687.11
...	....	....	4-5	B	93.67	3-4	B	93.98	4-5	n B	93.57	93.74	+4	5693.78
...	....	....	0-1	D	97.10	1	D	96.72	2	n D	96.49	96.77	+4	5696.81
5	n B	5704.61	3	B	05.58	3	n B	05.62	3	B	05.13	05.37	+4	5705.41
...	....	....	1-2	D	08.26	1-2	D	08.55	2-3	D	07.81	08.17	+4	5708.21
2	n B	5709.74	2	B	10.76	1-2	B	10.83	1-2	B	10.30	10.41	+4	5710.45
...	....	....	1	D	12.77	1	n D	13.35	1-2	D	12.57	12.90	+4	5712.94
...	....	....	1	B	14.96	...	....	.....	...	....	.....	14.96	+4	5715.00
...	....	....	3	B	16.82	5	n B	16.90	3	B	17.27	17.01	+4	5717.05

19 *PISCIUM* = 273 *SCHJELLERUP*—*Continued*

G 259			G 269			G 293			G 357			Mean Wave-Length		
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		t.m.			t.m.			t.m.			t.m.	t.m.		t.m.
6	B	5717.92	2	B	17.74	...	....	.....	...	....	.....	17.83	+4	5717.87
...	....	....	1	n D	22.01	1	n D	20.95	2	D	21.12	21.36	+4	5721.40
8	n B	5724.00	4–5	n B	24.31	2–3	B	24.13	2	B	23.80	24.08	+4	5724.12
1	D	5730.46	3	n D	31.76	3	n D	31.40	1–2	n D	31.41	31.16	+4	5731.20
...	....	....	2	n D	44.34	1	n D	44.75	3	n D	43.85	44.31	+4	5744.35
...	....	....	1	n B	46.95	1	n B	47.15	...	....	.....	47.05	+4	5747.09
...	....	....	1	n D	49.08	1	n D	50.02	...	....	.....	49.55	+4	5749.59
...	....	....	3	n B	56.89	2–3	n B	57.06	...	....	.....	56.98	+4	5757.02
...	....	....	3	n D	62.80	1	n D	62.59	2–3	n D	62.79	62.70	+4	5762.74
...	....	....	2–3	n B	66.90	1–2	n B	67.60	...	....	.....	67.25	+4	5767.29
...	....	....	2–3	n D	71.27	1	n D	70.73	4	n D	71.44	71.15	+4	5771.19
...	....	....	1–2	n B	75.49	1–2	n B	76.08	1	B	75.74	75.77	+4	5775.81
...	....	....	1	n D	77.76	1	n D	77.79	1	D	77.78	77.78	+4	5777.82
...	....	....	1–2	B	80.18	1–2	n B	79.73	1	B	79.55	79.82	+4	5779.86
...	....	....	3	n D	85.13	1	n D	85.92	...	....	.....	85.53	+4	5785.57
...	....	....	1–2	D	98.66	1	n D	98.61	1–2	D	98.16	98.64	+4	5798.68
...	....	....	1	n D	22.69	...	....	.....	1	D	22.69	22.69	+4	5822.73

280 *SCHJELLERUP*

Plate G 346 1899, October 18, G.M.T. 16h1. Hour angle, W 1h5 Star fair; comparison good						Plate G 367 1899, December 29, G.M.T. 11h2. Hour angle, W 4h ± Star fair; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	...	nn D	62.2999	4429.56	−34	4429.22	29.14	+37	4429.51
3	nn D	49.1115	4434.67	+ 9	4434.76	...	....	....	....	....	....	34.85	+37	4435.22
...	....	....	....	....	....	...	nn D	62.0955	4436.12	−35	4435.77	35.69	+37	4436.06
...	....	....	....	....	....	B	from	62.0720	4436.88	−35	4436.5	36.4	+37	4437.0
...	....	....	....	....	....		to	61.9785	4439.92	−36	4439.56	39.48	+37	4439.9
...	nn B	49.9832	4463.24	+ 5	4463.29	...	....	....	....	....	....	63.38	+38	4463.76
...	....	....	....	....	....	4	wn D	61.1895	4466.08	−42	4465.66	65.58	+38	4465.96
...	....	....	....	....	....	1	n D	61.0215	4471.77	−43	4471.34	71.26	+38	4471.64
...	nn D	50.5099	4481.06	+ 2	4481.08	1	n D	60.7203	4482.09	−45	4481.64	81.36	+38	4481.74
1	n D	50.7400	4488.98	+ 1	4488.99	1	n D	60.5093	4489.41	−47	4488.94	88.97	+38	4489.35
...	nn D	50.9450	4496.11	0	4496.11	...	wn D	60.2908	4497.07	−48	4496.59	96.35	+38	4496.73
...	nn D	51.0778	4500.76	− 1	4500.75	...	....	....	....	....	....	00.84	+38	4501.22
2	D	51.2257	4505.98	− 2	4505.96	2	n D	60.0242	4506.51	−48	4506.03	06.00	+38	4506.38
...	nn D	51.4054	4512.36	− 3	4512.33	3	nn D	59.8414	4513.06	−49	4512.57	12.45	+38	4512.83
1–2	nn D	51.5497	4517.53	− 4	4517.49	2	n D	59.6899	4518.53	−49	4518.04	17.77	+38	4518.15
1–2	nn B	51.6385	4520.73	− 5	4520.68	...	....	....	....	....	....	20.77	+38	4521.15
...	nn D	51.6825	4522.32	− 5	4522.27	1	n D	59.5592	4523.28	−49	4522.79	22.53	+38	4522.91
1	n B	51.7274	4523.94	− 5	4523.89	...	....	....	....	....	....	24.98	+38	4525.36
...	w D	51.8039	4526.73	− 5	4526.68	1–2	n D	59.4587	4526.96	−49	4526.47	26.58	+38	4526.96
...	....	....	....	....	....		from	59.352	4530.88	−49	4530.39	30.31	+38	4530.7
...	wn D	52.0274	4534.89	− 6	4534.83	D		....	....	....	....	34.92	+38	4535.30
...	....	....	....	....	....		to	59.213	4536.01	−49	4535.52	35.44	+38	4535.8
...	w B	52.1002	4537.58	− 7	4537.51	...	....	....	....	....	....	37.60	+38	4537.98
1	n D	52.1520	4539.49	− 7	4539.42	...	....	....	....	....	....	39.51	+38	4539.89
...	w D	52.5197	4553.21	− 9	4553.12	9	w D	58.7399	4553.76	−49	4553.27	53.20	+38	4553.58
B	from	52.569	4555.08	− 9	4555.0	...	....	....	....	....	....	55.09	+38	4555.5
	to	52.669	4558.86	− 9	4558.8	...	....	....	....	....	....	58.89	+38	4559.3
...	....	....	....	....	....	...	nn D	58.5685	4560.29	−48	4559.81	59.73	+38	4560.11
1	D	52.7667	4562.56	−10	4562.46	...	....	....	....	....	....	62.55	+38	4562.93
0–1	D	52.8267	4564.85	−10	4564.75	...	....	....	....	....	....	64.84	+38	4565.22
B	from	52.844	4565.52	−10	4565.4	...	....	....	....	....	....	65.48	+38	4565.9
	to	52.937	4569.09	−10	4569.0	...	....	....	....	....	....	69.08	+38	4569.5
...	nn D	52.9930	4571.41	−10	4571.31	...	nn D	58.2920	4571.53	−47	4571.06	71.15	+38	4571.53
...	....	....	....	....	....	...	nn D	58.1352	4577.06	−46	4576.60	76.52	+38	4576.90

280 *SCHJELLERUP—Continued*

PLATE G 346						PLATE G 367						MEAN WAVE-LENGTH		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
5-6	wn B	53.3020	4583.22	−10	4583.12	...	....	....	....	....	....	83.21	+38	4583.59
2	n D	53.3707	4585.91	−10	4585.81	2	n D	57.8917	4586.64	−45	4586.19	86.00	+38	4586.38
1	n D	53.5710	4593.82	−10	4593.72	...	....	....	....	....	....	93.81	+38	4594.19
2	nn B	53.6198	4595.74	−10	4595.64	...	....	....	....	....	....	95.73	+38	4596.11
1	n B	53.7070	4599.21	−10	4599.11	...	....	....	....	....	....	99.20	+38	4599.58
7	D	53.8745	4605.92	− 9	4605.83	8	D	57.3998	4606.35	−42	4605.93	05.88	+38	4606.26
...	....	....	....	....	....	B	from	57.3680	4607.64	−42	4607.22	07.14	+38	4607.5
3	n B	53.9284	4608.09	− 9	4608.00	...	....	....	....	....	....	08.09	+38	4608.47
1	n D	54.1182	4615.79	− 8	4615.71	to	nn D	57.1620	4616.06	−41	4615.65	15.68	+38	4616.06
4	B	54.1567	4617.35	− 8	4617.27	...	....	....	....	....	....	17.36	+38	4617.74
1	n D	54.1922	4618.80	− 8	4618.72	...	....	....	....	....	....	18.91	+38	4619.29
...	nn D	54.4330	4628.72	− 6	4628.66	...	....	....	....	....	....	28.75	+38	4629.13
4	n B	54.4779	4630.56	− 6	4630.50	...	n B	56.8002	4631.06	−38	4630.68	30.59	+38	4630.97
2	n B	54.6472	4637.61	− 5	4637.56	...	....	....	....	....	....	37.65	+38	4638.03
3	D	54.6947	4639.60	− 5	4639.55	...	nn D	56.5932	4639.77	−36	4639.41	39.48	+38	4639.86
...	....	....	....	....	....		from	56.5715	4640.69	−36	4640.33	40.25	+38	4640.6
...	....	....	....	....	....	B	....	....	....	....	....	41.72	+38	4642.10
1-2	n B	54.7444	4641.68	− 5	4641.63		to	56.4825	4644.47	−35	4644.12	44.04	+38	4644.4
3	D	54.8347	4645.49	− 4	4645.45	5	n D	56.4412	4646.23	−35	4645.88	45.67	+38	4646.05
...	....	....	....	....	....	...	nn D	56.2302	4655.27	−33	4654.94	54.86	+39	4655.25
...	....	....	....	....	....		from	56.1785	4657.50	−32	4657.18	57.10	+39	4657.5
2-3	n B	55.1780	4660.01	− 1	4660.00	B	....	....	....	....	....	60.09	+39	4660.48
...	....	....	....	....	....		to	56.0695	4662.23	−31	4661.92	61.84	+39	4662.2
1	D	55.2574	4663.44	0	4663.44	...	....	....	....	....	....	63.53	+39	4663.92
1	n B	55.2852	4664.73	0	4664.73	...	....	....	....	....	....	64.82	+39	4665.21
4	D	55.3172	4667.41	+ 1	4667.42	...	nn D	55.9283	4668.39	−29	4668.10	67.76	+39	4668.15
2	D	55.5047	4674.27	+ 3	4674.30	...	nn D	55.7829	4674.78	−28	4674.50	74.40	+39	4674.79
...	wn D	55.6657	4681.78	+ 5	4681.83	...	nn D	55.6204	4681.98	−27	4681.71	81.77	+39	4682.16
...	nn D	56.3944	4714.06	+17	4714.23	5	wn D	54.9117	4714.14	−18	4713.96	14.10	+39	4714.49
...	nn D	56.6945	4727.92	+22	4728.14	...	nn D	54.6045	4728.47	−17	4728.30	28.22	+39	4728.61
...	....	....	....	....	....	D	from	54.5010	4733.35	−17	4733.18	33.10	+39	4733.5
...	....	....	....	....	....		to	54.4140	4737.48	−16	4737.32	37.24	+39	4737.6
4	n B	56.9179	4738.38	+21	4738.62	...	....	....	....	....	....	38.71	+39	4739.10
...	....	....	....	....	....	B	to	54.3400	4741.00	−16	4740.84	40.76	+39	4741.2
...	....	....	....	....	....	D	from	54.3385	4741.07	−16	4740.91	40.83	+39	4741.2
10	wn D	57.0089	4742.67	+25	4742.92	...	....	....	....	....	....	43.01	+39	4743.40
...	Head	57.0499	4744.62	+25	4744.87	...	Head	54.2550	4745.06	−15	4744.91	44.89	+39	4745.28
...	n B	57.0845	4746.26	+25	4746.51	...	....	....	....	....	....	46.60	+39	4746.99
...	....	....	....	....	....	B	to	54.1801	4748.66	−14	4748.52	48.44	+40	4748.8
...	....	....	....	....	....	...	nn D	54.1429	4750.45	−14	4750.31	50.23	+40	4750.63
...	wn B	57.2724	4755.23	+27	4755.50	...	w B	54.0438	4755.25	−13	4755.12	55.31	+40	4755.71
5	n D	57.3385	4758.41	+27	4758.68	4	n D	53.9742	4758.63	−13	4758.50	58.59	+40	4758.99
1	n D	57.4955	4766.01	+28	4766.29	...	....	....	....	....	....	66.38	+40	4766.78
...	nn B	57.5354	4767.94	+28	4768.22	...	....	....	....	....	....	68.31	+40	4768.71
...	wn D	57.8460	4783.22	+30	4783.52	...	wn D	53.4997	4782.05	−10	4781.95	82.7±	+40	4783.1±
...	....	....	....	....	....	...	nn D	53.0248	4806.12	− 9	4806.03	05.95	+40	4806.35
...	nn B	58.4324	4812.73	+31	4813.04	...	....	....	....	....	....	13.13	+40	4813.53
2	n D	58.4695	4814.64	+31	4814.95	...	....	....	....	....	....	15.04	+40	4815.44
...	nn B	58.5190	4817.18	+31	4817.49	...	nn B	52.7895	4818.30	− 8	4818.22	17.86	+40	4818.26
...	....	....	....	....	....	...	nn D	52.7088	4822.51	− 8	4822.43	22.35	+40	4822.75
...	....	....	....	....	....	1	n D	52.6368	4826.28	− 8	4826.20	26.12	+40	4826.52
...	nn D	58.7982	4831.66	+30	4831.96	2	n D	52.5227	4832.30	− 8	4832.22	32.09	+40	4832.49
...	....	....	....	....	....	...	nn D	52.3259	4839.54	− 8	4839.46	39.38	+40	4839.78
...	....	....	....	....	....	...	nn B	52.0585	4857.18	− 9	4857.09	57.01	+41	4857.42
9	B	59.3436	4860.61	+27	4860.88	...	....	....	....	....	....	60.97	+41	4861.38
Limits of above		59.3192	4859.29	+27	4859.56	...	....	....	....	....	....	59.65	+41	4860.1
		59.3710	4862.08	+27	4862.35	...	....	....	....	....	....	62.44	+41	4862.9
3	D	59.4042	4863.88	+27	4864.15	...	nn D	51.9090	4865.34	−10	4865.24	64.70	+41	4865.11
...	....	....	....	....	....	...	nn D	51.7328	4875.05	−11	4874.94	74.86	+41	4875.27
...	....	....	....	....	....	B	from	51.7085	4876.40	−11	4876.29	76.21	+41	4876.6
...	....	....	....	....	....		to	51.6390	4880.26	−11	4880.15	80.07	+41	4880.5
...	....	....	....	....	....	Max	B	51.6740	4878.31	−11	4878.20	78.12	+41	4878.53
...	....	....	....	....	....	...	nn D	51.6105	4881.85	−11	4881.74	81.66	+41	4882.07
...	....	....	....	....	....	...	nn D	51.4683	4889.82	−12	4889.70	89.62	+41	4890.03
...	....	....	....	....	....	B	from	51.3685	4895.45	−13	4895.32	95.21	+41	4895.7
...	....	....	....	....	....		to	51.2960	4899.56	−14	4899.42	99.31	+41	4899.8

280 *SCHJELLERUP—Continued*

Plate G 366						Plate G 367						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	Max	B	51.3245	4897.94	−13	4897.81	97.73	+41	4898.14
...	....	....	....	....	....	1–2	nn D	51.2795	4900.51	−14	4900.37	00.29	+41	4900.70
...	....	....	....	....	....	...	nn D	50.9320	4920.49	−17	4920.32	20.24	+41	4920.65

280 *SCHJELLERUP*

Plate G 366 1899, December 28, G.M.T. 11h6. Hour angle, W 5h ± Star fair; comparison good						Plate G 370 1900, January 2, G.M.T. 11h1. Hour Angle, W 5h5 Star fair; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
Spectrum	begins	40.9180	5170.70	−43	5170.27	...	....	48.7620	5168.48	−29	5168.19	69.23	+42	5169.7
...	....	....	....	....	....	...	nn D	48.9115	5174.48	−33	5174.15	73.92	+43	5174.35
...	nn D	41.2347	5183.60	−43	5183.17	...	....	....	....	....	....	83.45	+43	5183.88
3	n D	41.4822	5193.76	−43	5193.33	2	n D	49.3884	5193.87	−45	5193.42	93.38	+43	5193.81
	from	41.7300	5204.03	−45	5203.58	...	....	....	....	....	....	03.81	+43	5204.3
D						...	w D	49.7851	5210.28	−51	5209.77	09.54	+43	5209.97
	to	41.9395	5212.78	−47	5212.31	...	....	....	....	....	....	12.54	+43	5213.0
...	wn D	42.2515	5225.95	−49	5225.46	8	w D	50.1743	5226.60	−55	5226.05	25.76	+43	5226.19
...	....	....	....	....	....	B	from	50.2250	5228.75	−56	5228.19	27.96	+43	5228.4
...	....	....	....	....	....		to	50.6380	5246.40	−57	5245.83	45.60	+43	5246.0
...	....	....	....	....	....	...	n D	50.3650	5234.70	−57	5234.13	33.90	+43	5234.33
...	nn D	42.7508	5247.38	−51	5246.87	2	n D	50.6702	5247.78	−56	5247.22	47.05	+43	5247.48
...	nn D	42.8324	5250.92	−51	5250.41	1	n D	50.7688	5252.04	−56	5251.48	50.95	+43	5251.4
5	n D	43.2787	5270.48	−49	5269.99	4	n D	51.2009	5270.91	−54	5270.37	70.18	+44	5270.62
2–3	n D	43.5644	5283.19	−48	5282.71	...	nn D	51.4825	5283.38	−50	5282.88	82.80	+44	5283.24
2	n D	43.8934	5298.01	−45	5297.56	...	nn D	51.8159	5298.33	−45	5297.88	97.72	+44	5298.16
1	n D	43.9923	5302.50	−45	5302.05	...	....	....	....	....	....	02.28	+44	5302.72
...	nn D	44.1069	5307.73	−43	5307.30	...	....	....	....	....	....	07.53	+44	5307.97
...	nn D	44.2664	5315.05	−41	5314.64	...	....	....	....	....	....	14.87	+44	5315.31
...	nn D	44.3880	5320.68	−40	5320.28	...	....	....	....	....	....	20.51	+44	5320.95
...	wn D	44.5779	5329.48	−36	5329.12	...	w D	52.5064	5329.94	−35	5329.59	29.36	+44	5329.80
...	nn D	44.7330	5336.73	−35	5336.38	...	....	....	....	....	....	36.61	+44	5337.05
...	...	....	....	....	....	1	n D	52.7540	5341.49	−32	5341.17	41.40	+44	5341.84
4	D	45.0102	5349.81	−30	5349.51	3	n D	52.9510	5350.76	−29	5350.47	49.99	+44	5350.43
...	...	....	....	....	....	2	B	53.0073	5353.43	−28	5353.15	52.92	+45	5353.37
...	...	....	....	....	....	Con. Spec.	from	53.0430	5355.12	−28	5354.84	54.61	+45	5355.1
...	...	....	....	....	....		to	53.3530	5369.93	−24	5369.69	69.46	+44	5369.9
10	w D	45.4645	5371.56	−25	5371.31	8	D	53.3993	5372.15	−23	5371.92	71.62	+45	5372.07
2	B	45.5302	5374.74	−25	5374.49	3	B	53.4640	5375.27	−22	5375.05	74.77	+45	5375.22
...	nn D	45.5707	5376.71	−24	5376.47	...	n D	53.5124	5377.81	−22	5377.59	77.03	+45	5377.48
	from	45.5880	5377.55	−24	5377.31	...	....	....	....	....	....	77.54	+45	5378.0
B						Max	B	53.5632	5380 07	−21	5379.86	80.09	+45	5380.54
	to	45.6610	5381.11	−23	5380.88	...	....	....	....	....	....	81.11	+45	5381.6
Con. Spec.	from	45.7350	5384.71	−22	5384.49	...	....	....	....	....	....	84.72	+45	5385.2
	to	45.8425	5389.98	−22	5389.76	...	....	....	....	....	....	89.99	+45	5390.4
...	nn D	45.8650	5391.09	−21	5390.88	...	nn D	53.7980	5391.52	−19	5391.33	91.11	+45	5391.56
6	D	45.9830	5396.91	−21	5396.70	4	n D	53.9200	5397.51	−17	5397.34	97.02	+45	5397.47
...	...	....	....	....	....		from	53.9680	5399.88	−17	5399.71	99.48	+45	5399.9
...	D	46.1617	5405.77	−19	5405.58	B						05.81	+45	5406.26
...	...	....	....	....	....		to	54.0840	5405.61	−16	5405.45	05.22	+45	5405.7
...	...	....	....	....	....	1	B	54.1377	5408.27	−15	5408.12	07.89	+45	5408.33
3	D	46.2497	5410.16	−18	5409.98	...	nn D	54.1800	5410.37	−15	5410.22	10.10	+45	5410.55
B	from	46.2950	5412.42	−18	5412.24	B	from	54.2520	5413.97	−14	5413.83	13.03	+45	5413.5
	to	46.4160	5418.49	−17	5418.31		to	54.3540	5419.07	−13	5418.94	18.61	+45	5419.1
...	...	....	....	....	....	Max	....	54.3223	5417.48	−13	5417.35	17.58	+45	5418.03
2–3	D	46.4445	5419.92	−17	5419.75	...	nn D	54.3795	5420.34	−12	5420.22	19.99	+45	5420.44

280 *SCHJELLERUP — Continued*

Plate G 366						Plate G 370						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
1-2	B	46.5025	5422.85	−17	5422.68	...	....	....	....	....	....	22.94	+45	5423.39
1	D	46.5524	5425.38	−16	5425.22	...	....	....	....	....	....	25.45	+45	5425.90
1-2	B	46.5820	5426.87	−16	5126.71	...	....	....	....	....	....	26.94	+45	5427.39
...	n D	46.6404	5429.84	−16	5429.68	...	nn D	54.5747	5430.18	−11	5430.07	29.88	+45	5430.33
...	....	....	....	....	....	1	n B	54.6125	5432.10	−10	5432.00	32.23	+45	5432.68
2	D	46.7243	5434.11	−15	5433.96	...	nn D	54.6612	5434.56	−10	5434.46	34.21	+45	5434.66
2	D	46.8110	5438.53	−15	5438.38	...	....	....	....	....	....	38.61	+45	5439.06
B	from	46.8465	5440.35	−15	5440.20	B	from	54.7800	5440.62	− 9	5440.53	40.37	+45	5440.8
	to	46.9510	5445.72	−14	5445.58		to	54.8940	5446.46	− 8	5446.38	45.98	+45	5446.4
4	D	46.9884	5447.65	−14	5447.51	...	nn D	54.9297	5448.28	− 8	5448.20	47.86	+45	5448.31
B	from	47.0290	5449.74	−14	5449.60	...	....	....	....	....	....	49.83	+46	5450.3
	....	....	....	....	....	6	w B	55.0112	5452.48	− 7	5452.41	52.18	+46	5452.64
	to	47.1195	5454.42	−13	5454.29	...	....	....	....	....	....	54.52	+46	5455.0
4	D	47.1517	5456.04	−13	5455.91	...	nn D	55.0857	5456.33	− 7	5456.26	56.08	+46	5456.54
1	B	47.2005	5458.63	−13	5458.50	2	n B	55.1330	5458.78	− 7	5458.71	58.61	+46	5459.07
2	D	47.2378	5460.57	−13	5460.44	...	....	....	....	....	....	60.67	+46	5461.13
2	B	47.2923	5463.42	−13	5463.29	3	n B	55.2310	5463.87	− 7	5463.80	63.55	+46	5464.01
...	nn D	47.3509	5466.48	−13	5466.35	1	n D	55.2845	5466.65	− 6	5466.59	66.47	+46	5466.93
...	nn D	47.5084	5474.76	−12	5474.64	1	n D	55.4374	5474.66	− 6	5474.60	74.62	+46	5475.08
...	....	....	....	....	....	1	n D	55.5940	5482.91	− 6	5482.85	82.62	+46	5483.08
1	n D	48.1050	5506.63	−13	5506.50	...	....	....	....	....	....	06.73	+46	5507.19
Con. Spec.	from	48.1300	5507.99	−13	5507.86	...	....	....	....	....	....	08.09	+46	5508.6
						4	n B	56.0978	5509.85	− 8	5509.77	09.54	+46	5510.00
	to	48.2095	5512.30	−13	5512.17							12.40	+46	5512.9
...	....	....	....	....	....	D	from	56.1430	5512.30	− 8	5512.22	11.99	+46	5512.5
5 6	w D	48.2440	5514.18	−13	5514.05		nn D					14.28	+46	5514.74
	....	....	....	....	....			56.2182	5516.37	− 9	5516.28	16.05	+46	5516.51
Con. Spec.	from	48.3070	5517.60	−13	5517.47		to	56.2390	5517.51	− 9	5517.42	17.45	+46	5517.9
	to	48.4820	5527.20	−11	5527.06	...	....	....	....	....	....	27.29	+46	5527.8
2	n D	48.5019	5528.30	−14	5528.16	...	....	....	....	....	....	28.39	+46	5528.85
2	n B	48.5527	5531.11	−14	5530.97	...	....	....	....	....	....	31.20	+46	5531.66
1	n D	48.5915	5533.24	−14	5533.10	...	....	....	....	....	....	33.33	+46	5533.79
D	from	48.6560	5536.80	−14	5536.66	...	....	....	....	....	....	36.89	+46	5537.4
	to	48.7470	5541.90	−15	5541.75	...	....	....	....	....	....	41.98	+46	5542.4
...	nn B	48.9644	5554.04	−17	5553.87	Max	B	56.9077	5554.43	−16	5554.27	54.07	+47	5554.54
...	nn D	49.0123	5556.74	−17	5556.57	...	....	....	....	....	....	56.80	+47	5557.27
...	nn D	49.1890	5566.74	−18	5566.56	...	nn D	57.1464	5567.88	−18	5567.70	67.13	+47	5567.60
...	n B	49.2732	5571.53	−19	5571.34	...	....	....	....	....	....	71.57	+47	5572.04
2	n B	49.4380	5580.96	−21	5580.75	3	n B	57.3880	5581.64	−21	5581.43	81.09	+47	5581.56
1 2	n D	49.4907	5583.99	−22	5583.77	1	n D	57.4430	5584.80	−21	5584.59	84.18	+47	5584.65
1-2	n D	49.5880	5589.61	−23	5589.38	..	nn D	57.5315	5589.89	−23	5589.66	89.52	+47	5589.99
...	n B	49.6457	5592.95	−23	5592.72	1	n B	57.5850	5592.98	−23	5592.75	92.74	+47	5593.21
...	n B	49.7184	5597.17	−24	5596.93	2	n B	57.6759	5598.24	−24	5598.00	97.47	+47	5597.94
...	....	....	....	....	....	Max	B	57.8240	5606.87	−26	5606.61	06.38	+47	5606.85
2	D	50.1167	5620.55	−28	5620.27	4	D	58.0629	5620.90	−28	5620.62	20.45	+47	5620.92
3	D	50.1994	5625.46	−29	5625.17	...	....	....	....	....	....	25.40	+47	5625.87
B	from	50.2330	5627.50	−30	5627.20	...	....	....	....	....	....	27.43	+47	5627.9
						6	w B	58.2215	5630.31	−29	5630.02	29.79	+47	5630.26
	to	50.3020	5631.61	−30	5631.31	...	....	....	....	....	....	31.54	+47	5632.0
8	D	50.3392	5633.81	−31	5633.50	6	n D	58.2827	5633.95	−30	5633.65	33.58	+47	5634.05
Head		50.3828	5636.42	−31	5636.11	Head		58.3305	5636.81	−30	5636.51	36.31	+47	5636.78
...	nn D	50.5230	5644.85	−33	5644.52	...	....	....	....	....	....	44.75	+47	5645.22
1	n D	50.6050	5649.82	−34	5649.48	...	....	....	....	....	....	49.71	+47	5650.18
B	from	50.6230	5650.93	−34	5650.59	...	....	....	....	....	....	50.82	+47	5651.3
	to	50.7215	5656.89	−35	5656.54	...	....	....	....	....	....	56.77	+47	5657.2
1-2	n D	50.7539	5658.87	−35	5658.52	...	....	....	....	....	....	58.75	+48	5658.23
...	n D	50.9637	5671.74	−37	5671.37	1	n D	58.9019	5671.44	−35	5671.09	71.23	+48	5671.71
1	B	51.0070	5674.41	−38	5674.03	...	....	....	....	....	....	74.26	+48	5674.74
2	D	51.0170	5676.88	−38	5676.50	1	n D	59.0010	5677.55	−36	5677.19	76.85	+48	5677.33
1-2	n D	51.2199	5687.62	−40	5687.22	...	....	....	....	....	....	87.45	+48	5687.93
...	nn B	51.3075	5693.09	−41	5692.68	...	....	....	....	....	....	92.91	+48	5693.39
...	....	....	....	....	....	...	wn B	59.2745	5694.53	−37	5694.16	93.93	+48	5694.41
...	....	....	....	....	....	1	B	59.3538	5699.50	−38	5699.12	98.89	+48	5699.37
...	....	....	....	....	....	2	nn B	59.4707	5706.85	−39	5706.46	06.23	+48	5706.71
2	n D	51.5520	5708.50	−43	5708.07	1	n D	59.5077	5709.19	−39	5708.80	08.44	+48	5708.92
...	nn B	51.6852	5716.97	−44	5716.53	Max	B	59.6410	5717.65	−40	5717.25	16.89	+48	5717.37

290 *SCHJELLERUP — Continued*

Plate G 366						Plate G 370						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
2	n B	51.7968	5724.11	−46	5723.65	Max	B	59.7514	5724.68	−41	5724.27	23.96	+48	5724.44
...	nn D	51.9112	5731.46	−47	5730.99	...	....	....	....	....	....	31.22	+48	5731.70
...	....	....	....	....	....	1-2	n D	59.8747	5732 60	−42	5732 18	31.95	+48	5732.43
...	....	....	....	....	....	B	from	59.9020	5734.40	−42	5733.98	33.75	+48	5734.2
...	....	....	....	....	....		to	60.0390	5743.30	−43	5742.87	42.64	+48	5743 1
...	nn D	52.1065	5744.10	−49	5743.61	...	....	....	....	....	....	43.84	+48	5744.32
...	nn D	52.2212	5751.60	−50	5751.10	1	n D	60.1725	5751.89	−44	5751.45	51.22	+48	5751.70
2-3	wn B	52.3143	5757.70	−50	5757.20	...	w B	60.2697	5758.25	−45	5757.80	57.57	+48	5758.05
...	wn D	52.4020	5763.48	−50	5762.98	...	....	....	....	....	....	63.21	+48	5763.69
...	....	....	....	....	....	2	n B	60.4330	5769.00	−46	5768.54	68.31	+48	5768.79
1	n D	52.5380	5772.49	−50	5771.99	1	n D	60.4740	5771.71	−46	5771.25	71.62	+48	5772.10
...	....	....	....	....	....	2	n B	60.6135	5780.98	−46	5780.52	80.29	+48	5780.77
...	....	....	....	....	....	End	....	61.9530	5873.40	−50	5872 90	72.67	+48	5873.

318 *BIRMINGHAM = DM. 68°617*

Plate G 276 1899, January 15, G.M.T. 16h4. Hour angle, E 4h4 Star good; comparison fair						Plate G 393 1900, March 31, G.M.T. 18h±. Hour angle, W 2h2 Star excellent; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	nn D	64.0863	4389.68	+ 9	4389.77	...	nn D	56.1606	4390.45	−47	4389.98	89.88	+15	4390.03
...	nn D	63.7893	4395.06	+ 8	4395.14	...	wn D	56.4269	4395.37	−48	4394.89	95.02	+15	4395.17
...	wn D	63.4673	4400.94	+ 7	4401.01	...	nn D	56.7340	4401.10	−50	4400 60	00.87	+15	4401.02
2	n B	63.3981	4402.21	+ 6	4402.27	5	n B	56.8282	4402.86	−50	4402.36	02.32	+15	4402.47
2-3	nn D	63.2537	4404.86	+ 5	4404.91	...	wn D	56.9736	4405.59	−51	4405.08	05.00	+15	4405.15
...	wn D	63.0670	4408.30	+ 4	4408.34	...	....	....	....	....	....	08.37	+15	4408.52
...	....	....	....	....	....	B	from	57.2130	4410.10	−52	4409.58	09.55	+15	4409.70
...	....	....	....	....	....		to	57.4510	4414.60	−53	4414.07	14.04	+15	4414.2
2-3	n D	62.7075	4415.01	+ 3	4415.04	...	nn D	57.4915	4415.41	−53	4414.88	14.96	+15	4415.11
2	n D	62.1355	4425.81	+ 1	4425.82	1	n D	58.0494	4426.15	−55	4425.60	25.71	+15	4425.86
3	n D	62.0466	4427.50	0	4427.50	2	n D	58.1354	4428 66	−55	4428.11	27.81	+15	4427.96
...	nn D	61.9070	4430.16	0	4430.16	1-2	n D	58.2797	4430.63	−55	4430.08	30.12	+15	4430.27
...	....	....	....	....	....	B	from	58.3200	4431.40	−56	4430.84	30.81	+15	4431.0
...	....	....	....	....	....		to	58.4530	4434.00	−56	4433.44	33.41	+15	4433.6
...	....	....	....	....	....	Max	B	58.3650	4432.29	−56	4431.73	31.70	+15	4431.85
1	n D	61.7190	4433.80	− 1	4433.79	...	nn D	58.4726	4434.40	−56	4433.84	33.81	+15	4433.96
...	wn D	61.6256	4435.57	− 1	4435.56	5	nn D	58.5374	4435.67	−56	4435.11	35.34	+15	4435.49
2	n D	61.4923	4438.15	− 2	4438.13	1	nn D	58.6850	4438.58	−56	4438.02	38.08	+15	4438.23
...	B	61.4420	4439.10	− 2	4439.08	5-6	n B	58.7336	4439.54	−56	4438.98	38.95	+15	4439.10
1-2	D	61.1761	4444.30	− 3	4444.27	...	....	....	....	....	....	44.30	+15	4444.45
...	....	....	....	....	....	B	from	59.0300	4445.43	−57	4444.86	44.83	+15	4445.0
...	....	....	....	....	....		to	59.1260	4447.30	−57	4446.73	46.70	+15	4446.9
...	wn D	61.0220	4447.31	− 4	4447.27	2	n D	59.1557	4447.94	−57	4447.37	47.32	+15	4447.47
2	n B	60.9604	4448.52	− 4	4448.48	6	n B	59.2095	4449.01	−57	4448.44	48.46	+15	4448.61
...	wn D	60.8905	4449.90	− 4	4449.86	...	wn D	59.2829	4450.49	−57	4449.92	49.89	+15	4450.04
2	n D	60.7160	4453.34	− 5	4453.29	1	n D	59.4432	4453.71	−58	4453.13	53.21	+15	4453.36
...	nn D	60.6218	4455.21	− 5	4455.16	1	n D	59.5472	4455.81	−58	4455.23	55.20	+15	4455.35
...	nn D	60.3790	4460.00	− 6	4459.94	...	....	....	....	....	....	59.97	+15	4460.12
...	wn D	60.2858	4461.91	− 6	4461.85	3	n D	59.8792	4462.56	−58	4461.98	61.92	+15	4462.07
4	n B	60.1904	4463.82	− 7	4463.75	8	wn B	59.9664	4464.34	−58	4463.76	63.76	+15	4463.91
...	....	....	....	....	....	1	n D	60.0417	4465.89	−58	4465.31	65.28	+15	4465.43
1	nn D	59.8040	4471.62	− 8	4471.54	...	....	....	....	....	....	71.57	+15	4471.72
...	....	....	....	....	....	B	from	60.3810	4472.90	−58	4472 32	72.29	+15	4472.4
...	....	....	....	....	....		to	60.4880	4474.90	−57	4474.33	74.30	+15	4474.5
1	n D	59.5902	4475.98	− 8	4475.90	...	....	....	....	....	....	75.93	+15	4476.08

318 *BIRMINGHAM — Continued*

PLATE G 276						PLATE G 393						MEAN WAVE-LENGTH		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	1	nn D	60.7596	4480.77	−57	4480.20	80.27	+15	4480.42
2-3	nn D	59.2813	4482.32	− 9	4482.23	2	nn D	60.8585	4482.85	−57	4482.28	82.26	+15	4482.41
...	....	....	....	....	....	2	n B	60.9177	4484.09	−57	4483.52	83.49	+15	4483.64
...	....	....	....	....	....	1-2	n B	61.0422	4486.71	−56	4486.15	86.12	+15	4486.27
...	nn D	59.0411	4487.28	− 9	4487.19	2	nn D	61.0989	4487.91	−56	4487.35	87.27	+15	4487.42
3	n D	58.9247	4489.70	−10	4489.60	3	n D	61.2096	4490.26	−56	4489.70	89.65	+15	4489.80
...	wn D	58.5813	4496.89	−10	4496.79	...	wn D	61.5444	4497.40	−55	4496.85	96.82	−15	4496.97
2-3	nn D	58.3523	4501.73	−10	4501.63	...	nn D	61.7749	4502.35	−54	4501 81	01.72	−15	4501.87
B	from	58.3210	4502 40	−10	4502.30	B	from	61.8060	4503.00	−54	4502.46	02.38	−15	4502.5
	to	58.4400	4506.20	−10	4506.10		to	61.9770	4506.70	−53	4506.17	06.14	−15	4506.3
Max	B	58 2340	4504.20	−10	4504.10	...	....	....	....	....	....	04.13	−15	4504.3
2	n D	58.1063	4506.96	−10	4506.86	3	n D	62.0142	4507.53	−53	4507.00	06.93	−15	4507.08
...	....	....	....	....	....	6	n B	62.0837	4509.05	−53	4508.52	08.49	−15	4508.64
1	nn D	57.9765	4509.10	− 9	4509.01	1	n D	62.1421	4510.32	−52	4509.80	09.41	−15	4509.56
...	....	....	....	....	....	2	nn D	62.2669	4513.05	−51	4512.52	12.49	−15	4512.64
4	wn D	57.5856	4518.15	− 8	4518.07	2	n D	62.5267	4518.75	−50	4518.25	18.16	−15	4518.31
...	....	....	....	....	....	3	wn B	62 6753	4522.04	−49	4521 55	21.52	−15	4521.67
5	wn D	57.3650	4522.94	− 8	4522.86	4	n D	62.7391	4523.45	−49	4522.96	22.91	−15	4523.06
1	nn D	57.1090	4528.54	− 7	4528.47	...	....	....	....	....	....	28.50	−15	4528.65
1	nn D	56.9826	4531.32	− 6	4531.26	...	nn D	63.1029	4531.57	−47	4531.10	31.18	−15	4531.43
...	nn D	56.7810	4535.78	− 6	4535.72	...	nn D	63.3017	4536.11	−46	4535.65	35.69	−15	4535.84
...	....	....	....	....	....	B	from	63.3420	4536.90	−46	4536.44	36.41	−15	4536.6
3	wn B	56.7118	4537.25	− 5	4537.20			....	....	....	....	37.23	−15	4537.38
2	n B	56.6471	4538.76	− 5	4538 71			....	....	....	....	38.74	−15	4538.89
...	....	....	....	....	....		to	63.4790	4540 00	−45	4539.55	39.52	−15	4539.7
...	nn D	56.5708	4540.46	− 5	4540.41	4	n D	63.5097	4540.76	−45	4540.31	40.36	−15	4540.51
...	nn D	56.3491	4545.43	− 3	4545.40	...	wn D	63.7440	4546.10	−44	4545.66	45.53	−15	4545.68
1	nn D	56.2963	4546.61	− 3	4546.58	...	....	....	....	....	....	46.61	−15	4546.76
...	....	....	....	....	....	4	n B	63.8277	4548.02	−43	4547.59	47.56	−15	4547.71
...	wn D	56.1758	4549.33	− 2	4549.31	...	nn D	63.8949	4549.56	−43	4549.13	49.22	−15	4549.37
D	from	56.0490	4552.20	− 1	4552.19	D	from	64.0240	4552.54	−41	4552.13	52.16	−15	4552.3
	to	55.9160	4555.20	0	4555.20		to	64.1530	4555.50	−41	4555.09	55.15	−15	4555.3
Max	D	55.9955	4553.41	− 1	4553.40	...	....	....	....	....	....	53.43	−15	4553.58
B	from	55.9160	4555.20	0	4555.20	B	from	64.1530	4555.50	−41	4555.09	55.15	−15	4555.3
	to	55.7430	4559.20	+ 1	4559.21		to	64.3290	4559.60	−39	4559.21	59.21	−15	4559.4
...	nn D	55.6930	4560.30	+ 1	4560.31	1	nn D	64.2470	4557.70	−40	4557.30	57.27	−15	4557.42
4	nn D	55.5614	4563.34	+ 2	4563.36	5	nn D	64 3721	4560.61	−39	4560.22	60.27	−15	4560.42
2	nn D	55.4598	4565.68	+ 2	4565 70	2	n D	64.5082	4563 79	−38	4563.41	63.39	−15	4563.54
B	from	55.4400	4566.10	+ 3	4566.13	1	n D	64.5934	4565.79	−37	4565.42	65.56	−15	4565.71
	to	55.2430	4570.70	+ 4	4570.74	B	from	64.6160	4566.30	−37	4565.93	66.03	−15	4566.2
D	from	55.2430	4570.70	+ 4	4570.74		to	64.7900	4570.40	−36	4570.04	70.39	−15	4570.5
		....	....	....	....	...	....	....	....	....	....	70.77	−15	4570.9
	to	54.9870	4576.70	+ 5	4576.75	...	wn D	64.8579	4572.02	−35	4571.67	71.64	−15	4571.79
...	....	....	....	....	....	...	nn D	61.9976	4575.33	−35	4574.98	74.95	−15	4575.10
1	nn D	54.9575	4577.37	+ 6	4577.43	...	....	....	....	....	....	76.78	−15	4576 9
1	nn D	54.8243	4580.50	+ 7	4580.57	...	nn D	65.0907	4577.55	−34	4577.21	77.32	−15	4577.47
...	....	....	....	....	....	...	nn D	65.2140	4580.50	−33	4580.17	80.37	−15	4580.52
...	....	....	....	....	....	1	nn D	65.3089	4582.77	−32	4582.45	82.42	−15	4582.57
...	....	....	....	....	....	1	n D	65.4024	4585.01	−31	4584.70	84.67	−15	4584.82
...	....	....	....	....	....	1	nn D	65.4560	4586.30	−31	4585.99	85.96	−15	4586.1
1	nn D	54.3836	4590.94	+ 9	4591.03	1-2	nn D	65.6686	4591.45	−29	4591.16	91 10	−15	4591.25
2	nn D	54.2548	4594.02	+10	4594.12	...	....	....	....	....	....	94.15	−15	4594.30
...	....	....	....	....	....	5	n B	65.8661	4596.26	−28	4595.98	95.95	−15	4596.10
...	....	....	....	....	....	2	n D	65.9276	4597.76	−27	4597.49	97.46	−15	4597.61
3	nn D	53.9766	4600.71	+11	4600.82	3	n D	66.0637	4600.36	−26	4600.10	00.46	−15	4600.61
D	from	53.7840	4605.40	+12	4605 52	...	....	....	....	....	....	05.55	−15	4605.7
	to	53.6760	4608.00	+13	4608.13	...	....	....	....	....	....	08.16	−15	4608.3
10	wn D	53.7343	4606.59	+12	4606.71	10	D	66.3012	4606.95	−25	4606.70	06.71	−15	4606.86
B	from	53.6760	4608.00	+13	4608.13	...	....	....	....	....	....	08.16	−15	4608.3
		....	....	....	....	2	n B	66.3959	4609.31	−24	4609.07	09.04	−15	4609.19
		....	....	....	....	1	nn D	66.4517	4610.69	−24	4610.45	10 42	−15	4610.57
		....	....	....	....	1	n B	66.5241	4612.50	−23	4612.27	12.24	−15	4612.39
	to	53.4800	4612.80	+13	4612.93	...	....	....	....	....	....	12.96	15	4613.1
2	n D	53.4613	4613.27	+14	4613.41	2 3	n D	66.5834	4613.97	−22	4613.75	13.58	−15	4613.73

318 *BIRMINGHAM—Continued*

Plate G 276						Plate G 363						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
5	n B	53.3983	4614.81	+14	4614.95	6	n B	66.6355	4615.28	+22	4615.06	15.00	+15	4615.15
3-4	n D	53.3478	4616.06	+14	4616.20	4	n D	66.6895	4616.63	+22	4616.41	16.31	+15	4616.46
8	n B	53.2801	4617.73	+14	4617.87	7	n B	66.7479	4618.09	+21	4617.88	17.88	+15	4618.03
6	n D	53.2061	4619.56	+15	4619.71	6	n D	66.8206	4619.92	+21	4619.71	19.71	+15	4619.86
5	n B	53.1385	4621.23	+15	4621.38	...	....	....	....	....	....	21.41	+15	4621.56
2-3	nn D	53.0779	4622.74	+15	4622.89	2	nn D	66.9471	4623.11	+20	4622.91	22.90	+15	4623.05
...	....	....	....	....	....	8	n D	67.2030	4629.60	+18	4629.42	29.39	+15	4629.54
...	....	....	....	....	....	2	n B	67.2736	4631.40	+18	4631.22	31.19	+15	4631.34
3	n B	52.4395	4638.77	+18	4638.95	3-4	n B	67.5707	4639.28	+16	4639.12	39.04	+15	4639.19
6	D	52.3870	4640.10	+18	4640.28	6	n D	67.6277	4640.49	+16	4640.33	40.31	+15	4640.46
...	....	....	....	....	....		from	67.6610	4641.36	+15	4641.21	41.18	+15	4641.3
4	wn B	52.3214	4641.77	+18	4641.95	B		....	....	....	....	42.01	+15	4642.16
							to	67.7680	4644.10	+14	4643.96	43.93	+15	4644.1
Complete absorption														
							from	71.0540	4734.12	+ 4	4734.16	34.13	+16	4734.3
10	w D	48.8333	4735.84	+27	4736.11	D		....	....	....	....	36.14	+16	4736.30
...	....	....	....	....	....		to	71.1830	4737.80	+ 4	4737.84	37.81	+16	4738.0
...	....	....	....	....	....		from	71.1830	4737.80	+ 4	4737.84	37.81	+16	4738.0
5-6	n B	48.7468	4738 31	+27	4738.58	B	4 n B	71.2102	4738.64	+ 4	4738.68	38.63	+16	4738.79
1	n D	48.6991	4739.68	+27	4739.95			....	....	....	....	39.98	+16	4740.14
...	....	....	....	....	....		to	71.3100	4741.50	+ 4	4741.54	41.51	+16	4741.7
10	D	48.5694	4743.41	+27	4743.68	10	w D	71.3881	4743 83	+ 5	4743.88	43.78	+16	4743.94
...	....	....	....	....	....	t's	from	71.3100	4741.50	+ 4	4741.54	41.51	+16	4741.7
...	....	....	....	....	....		to	71.4440	4745.40	+ 5	4745.45	45.42	+16	4745.6
Head	....	48.5081	4745.18	+27	4745.45	Head	....	71.4469	4745.55	+ 5	4745.60	45.53	+16	4745.69
4	n B	48.4736	4746.17	+27	4746.44	...	w B	71.4866	4746.72	+ 6	4746.78	46.61	+16	4746.77
...	nn D	48.3766	4748.98	+27	4749.25	...	nn D	71.5777	4749.39	+ 6	4749.45	49.34	+16	4749.50
...	nn D	48.0661	4758.04	+27	4758.31	4	n D	71.8869	4758.54	+ 7	4758.61	58.46	+16	4758.62
...	nn D	47.7955	4766.01	+27	4766.28	...	....	....	....	....	....	66.31	+16	4766.47
...	nn D	47.5756	4772.54	+27	4772.81	2-3	nn D	72.3619	4772.79	+ 9	4772.88	72.85	+16	4773.01
...	....	....	....	....	....	2	n B	73.5757	4810.30	+12	4810.42	10.39	+16	4810.54
...	nn D	46.2956	4811.58	+26	4811.84	...	....	....	....	....	....	11.87	+16	4812.03
...	....	....	....	....	....	2	n B	73.6842	4813.73	+12	4813.85	13.82	+16	4813.98
3	n D	46.1761	4815.32	+26	4815.58	4	n D	73.7416	4815.23	+11	4815.34	15.46	+16	4815.62
3	n D	45.9228	4823.29	+26	4823.55	3	nn D	73.9984	4823.74	+11	4823.85	23.70	+16	4823.86
3	n D	45.7775	4827.89	+25	4828.14	3	nn D	74.1264	4827.85	+10	4827.95	28.05	+16	4828.21
3	n B	45.7108	4830.02	+25	4830.27	...	....	....	....	....	....	30.30	+16	4830.46
3	n D	45.6461	4832.08	+25	4832.33	6	n D	74.2666	4832.37	+10	4832.47	32.40	+16	4832.56
1	D	45.3000	4843.19	+24	4843.43	...	....	....	....	....	....	43.46	+16	4843.62
...	nn D	44.9356	4855.05	+23	4855.28	...	....	....	....	....	....	55.31	+16	4855.47
...	....	....	....	....	....	1	n B	75.0324	4857.49	+ 6	4857.55	57.52	+16	4857.68
...	nn D	44.4424	4871.35	+21	4871.56	...	D	75.4577	4871.75	+ 3	4871.78	71.67	+16	4871.83
...	nn D	44.3110	4875.74	+21	4875.95	...	....	....	....	....	....	75.98	+16	4876.14
4	n D	44.1501	4881.15	+20	4881.35	2	n D	75.7421	4881.41	+ 1	4881.42	81.39	+16	4881.55
...	....	....	....	....	....	2	nn D	75.8584	4885.39	0	4885.39	85.36	+16	4885.52
2-3	n D	43.5808	4900.54	+17	4900.71	...	nn D	76.3069	4900 89	− 3	4900.86	00.79	+16	4900.95
...	wn D	42.9971	4920.85	+14	4920.99	...	nn D	76.8594	4920.35	− 8	4920.27	20.62	+16	4920.78
1	nn D	42.8823	4924.91	+14	4925.05	...	....	....	....	....	....	.....	....	....
1	D	42.6213	4934.16	+12	4934.28	...	....	....	....	....	....	.....	....	....
1-2	n D	41.9581	4958.13	+ 8	4958.21	...	....	....	....	....	....	.....	....	....
...	nn D	40.8214	5000.66	+ 1	5000.67	...	....	....	....	....	....	.....	....	....

318 *BIRMINGHAM*

PLATE G 253 1898, December 26, G.M.T. 21h7 Hour angle, E 0h5 Star good; comparison good						PLATE G 284 1899, January 20, G.M.T. 17h8 Hour angle E 2h7 Star good; comparison fair						PLATE G 379 1900, January 25, G.M.T. 20h7 Hour angle, W 0h4 Star fair; comparison good						MEAN WAVE-LENGTH		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
Spec	begin	45 779	5165 9	+24	5166 1	Begins		44 895	68 30	+22	68.52							68 63	+17	5168.8
..	n B	45 8612	5169 92	+24	5170 16															
.	wn D	45.9300	5172 64	+24	5172 88	4	n D	44 7710	73.14	+21	73.35							73 46	+17	5173.63
Max	B	46 0148	5176 00	+23	5176 23															
...	wn D	46 1881	5182 91	+23	5183 14		nn D	44 5124	83 26	+18	83 44							83.55	+17	5183.72
B {	from	46 2390	5184 90	+22	5185 12															
						1	n D	44 3792	88 51	+16	88 67							88 78	+17	5188.95
	to	46 3930	5191 10	+22	5191.32															
.	n D	46 4345	5192 82	+21	5193 03	6	wn D	44 2657	93 00	+15	93 15							93 26	+17	5193.43
	from	46.4710	5194 30	+21	5194.51															
B {						1	nn D	44 0207	02.76	+11	02 87							02.98	+17	5203 15
	to	46 7090	5201 00	+20	5201 20															
	from	46.7250	5204.60	+20	5204 80	D {	from	43 9770	01.50	+11	04 61							04.72	+17	5204.9
D }							4 D	43 9520	05 52	+10	05.62							05.73	+17	5205.90
	to	46.8830	5211.10	+19	5211 29		to	43 8070	11.30	+ 8	11 38							11.49	+17	5211.7
3 4	n B	46 9365	5213 28	+19	5213 47															
1	n D	47 0072	5216 20	+18	5216.38	2-3	nn D	43 6873	16 20	+ 5	16 25							16.36	+17	5216.53
B {	from	47 0260	5217 00	+18	5217 18															
	to	47 1980	5221 10	+16	5221 26															
4	n D	47.2153	5226.07	+16	5226 23	8	wn D	43 4450	26 07	− 2	26 05							26 16	+17	5226.33
	n B	47 3310	5229 65	+16	5229 81															
	nn D	47 4150	5233 17	+15	5233 32	2-3	n D	43 2513	34 03	− 9	33 94							34.05	+17	5234.22
	wn B	47 4868	5236 19	+15	5236.34															
						2	n D	43 1179	39 54	−13	39 41							39.52	+17	5239.69
1	nn D	47 7116	5246 96	+14	5247 10	3	n D	42 9323	47 27	−19	47 08							47 17	+17	5247.34
2	nn D	47 8344	5250.91	+13	5251 04	3	n D	42 8385	51 19	−20	50 99							51 10	+18	5251.28
						2	nn D	42 7353	55 52	−21	55 31							55.42	+18	5255 60
5	n D	48 2738	5269 81	+10	5269 91	5	D	42 3943	69 96	−23	69.73							69.84	+18	5270.02
	nn B	48 4968	5279 53	+ 8	5279 61	2	n B	42 1687	79 62	−23	79 39							79.50	+18	5279 68
6	wn D	48.8945	5297 08	+ 5	5297 13	3	n D	41 7517	97 70	−22	97 48							97.59	+18	5297.77
						1	nn D	41 6502	02 15	−20	01 95							02.06	+18	5302.24
	wn B	49 0576	5304 36	+ 5	5304 41	2-3	nn B	41.5909	04 75	−20	04 55							04.66	+18	5304.84
	nn D	49 1196	5307 15	+ 4	5307 19	2	nn D	41.5407	06 97	−19	06 78							06.89	+18	5307.07
3	n B	49 2443	5312 75	+ 4	5312 79	3	n B	41 4072	12 87	−18	12 69							12.80	+18	5312.98
3	nn D	49 2882	5314 74	+ 4	5314 78	2	n D	41.3590	15 01	−18	14 83							14.94	+18	5315.12
6	wn B	49 3476	5317 43	+ 4	5317 47	6	n B	41 3043	17 44	−16	17 28							17.39	+18	5317.57
2	n D	49 4102	5320 26	+ 4	5320 30															
3	n D	49 5865	5328 30	+ 4	5328 34	5	D	41 0564	28 53	−12	28 41							28.52	+18	5328.70
5	n B	49 7205	5334 45	+ 4	5334 49	Max	B	40 9317	34 14	−11	34 03							34.14	+18	5334.32
1	n D	49 7540	5335 99	+ 4	5336 03	1	nn D	40 8765	36 64	−10	36 54							36.65	+18	5336 83
						3	B	40 8279	38 84	− 8	38.76							38 87	+18	5339.05
2	nn D	49 8545	5340 64	+ 4	5340 68	4	n D	40 7797	41 03	− 7	40 96							41.07	+18	5341.25
	wn D	50 0278	5348 68	+ 5	5348 73															
B {	from	50 0720	5350 70	+ 5	5350 75															
	to	50 2820	5360 60	+ 6	5360 66															
	nn D	50 3140	5362 10	+ 6	5362 16															
4	nn D	50 3965	5365.85	+ 7	5365.92	2	n D	40 2327	66 17	+ 1	66 18							66.29	+18	5366 47
						3	n B	40 1854	68 37	+ 2	68 39							68.50	+18	5368.68
6	D	50 5040	5371 09	+ 8	5371 17	6	D	40 1225	71 30	+ 3	71 33	6	D	52 9072	71.31	− 3	71 28	71.31	+18	5371.49
6	n B	50 5655	5374 02	+ 8	5374 10	8	n B	40 0522	74 59	+ 4	74 63							74.74	+18	5374.92
2	n D	50.6173	5376.49	+ 9	5376 58	2	n D	40 0004	77 02	+ 5	77 07							77.18	+18	5377.36
	wn B	50 6815	5379 56	+ 9	5379 65	6-8	nn B	39 9500	79 38	+ 5	79.43							79.54	+18	5379.72
2	nn D	50 7893	5384 73	+10	5384 83															
4	nn B	50 9123	5392 12	+12	5392 24															
4	wn D	51 0305	5396 39	+13	5396 52		nn D	39 5888	96 49	+ 9	96 58							96 63	+18	5396.81
Max	B	51 1425	5401 85	+14	5402 01	Max	B	39 4460	03 32	+11	03 43							03 54	+18	5403.72
2	nn D	51 2023	5409.18	+16	5409 34	1	n D	39 3079	09 97	+11	10 08							10 19	+18	5410.37
						1	B	39 2649	12 05	+12	12 17							12.28	+18	5412.46
1	nn D	51 3716	5413 23	+17	5413 40	1	n D	39 2348	13.50	+12	13 62							13.73	+18	5413.91
8	n B	51 4313	5416 03	+18	5416.21		w B	39 1788	16 22	+13	16 35							16.46	+18	5416.64
3	nn D	51 5002	5419 44	+18	5419 62	2-3	n D	39 1062	19 80	+13	19 93							20 04	+18	5420.22
						6	B	39 0527	22 36	+13	22 49							22.60	+18	5422.78
1	nn D	51 6013	5424 46	+19	5424 65	4	nn D	39 0110	24 40	+13	24 53							24 64	+18	5424.82
						5	n B	38.9732	26 24	+14	26 38							26.49	+18	5426.67
4	n D	51 6971	5429 25	+20	5429.45	4	n D	38.9027	29 70	+14	29 84							29 95	+18	5430.13
						2	B	38 8620	31 70	+14	31 84							31.95	+18	5432.13
1	n D	51 7923	5434 01	+20	5434 21	2	n D	38 8245	33.55	+15	33.70							33.81	+18	5433 99
1	nn D	51 8594	5437 37	+20	5437 57	1	nn D	38 7418	37 63	+15	37 78							37.89	+18	5438 07
B {	from	51.8920	5439 01	+21	5439 22	B {	from	38 7480	38 80	+15	38.95							39 06	+18	5439.2
	to	52.0100	5445.00	+22	5445 22		to	38 5890	45 20	+16	45 36							45 47	+18	5445.7
9	n D	52 0168	5446 85	+22	5447 07	6	n D	38 5452	47 38	+16	47.54	4	n D	54 4493	47.54	−12	47 42	47 48	+18	5447.66
5	n B	52 1056	5449 84	+22	5450 06	5	B	38 4880	50 24	+16	50.40		nn B	54 5060	50 43	−12	50 31	50 36	+18	5450.54
3	n B	52 1610	5452 66	+23	5452 89															
2	n D	52 2223	5455 79	+23	5456 02	2	n D	38 3734	55 98	+16	56 14							56 25	+18	5456.43
						1	B	38 3240	58 46	+17	58 63							58 74	+18	5458 92
2	n D	52 2985	5459 70	+23	5459 93	2	n D	38 2898	60 18	+17	60 35		nn D	54 7115	61 29	12	61 17	60 76	+18	5460.94
	from	52.3180	5460 70	+23	5460 93															
B {						2	B	38 2509	62 44	+17	62.31							62.42	+18	5462.60
	to	52.4030	5465 10	+21	5465 31															
	from	52 4030	5465 10	+21	5465 31															
D {	mid	52.4533	5467 66	+24	5467 90	2	n D	38 4628	66 60	+17	66 77							66 88	+18	5467.06
	to	52 4920	5469 70	+21	5469 91															
8	n B	52 5188	5471 05	+24	5471 29	6	B	38 0615	71 74	+17	71 91		nn B	54 9223	71 92	−11	71 81	71 86	+18	5472 04
1 2	n D	52 5617	5473 27	+25	5473 52	2	n D	38 0189	73 91	+18	74 09							74 20	+18	5474 38
						2	n D	37 9567	77 09	+18	77 27							77 38	+18	5477.56
2 3	n B	52 6843	5479 65	+25	5479 90															

318 *BIRMINGHAM* = *DM* + 68 617 — *Continued*

Plate G 253						Plate G 284						Plate G 379						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
1	n D	52.7281	5481.94	+25	5481 19	1	nn D	37.8495	82.58	+18	82.76							82.87	+18	5483 05
1	n B	52.7995	5485 68	+26	5485.64															
2	n D	53.0162	5497 10	+26	5497 36	3	n D	37.5652	97.26	+19	97.45							97.56	+18	5497 74
2	n D	53 0934	5501 17	+26	5501.43	1	nn D	37.4788	01 76	+19	01.95							02 06	+18	5502.24
						0-1	nn D	37.3865	06.58	+19	06.77							06.88	+18	5507.06
5	n B	53.2206	5507 96	+26	5508.22															
2	nn D	53.2798	5511 13	+26	5511.39															
	from	53.3060	5513.10	+26	5513.36															
B	Max	53.4642	5519 97	+26	5520.23															
	to	53.4870	5522.30	+26	5522.56															
						2	n D	37.0588	23.87	+19	24.06							24 17	+18	5524 35
						1	nn D	36.9698	28.61	+19	28.80							28.91	+18	5529.09
2	nn B	53.6433	5530.75	+26	5531.01															
						1	nn D	36 8800	33.41	+19	33 60							33.71	+18	5533 89
7	n D	53.7900	5538.36	+26	5538.62	10	w D	36.7890	38.29	+19	38 48	7	D	56 1868	39.60	0	39.60	39 04	+18	5539.22
							from	36 7350	41.20	+19	41.39							41.50	+18	5541.7
9	n B	53.8583	5542.51	+25	5542 76	B														
1	nn D	53.9050	5545.10	+25	5545.35															
							to	36.6330	46.70	+19	46 89							47.00	+18	5547.2
1	n D	53.9591	5548 06	+25	5548.31	1-2	n D	36 6122	47.83	+19	48.02							48.13	+18	5548.31
1	n D	54.0165	5551.23	+25	5551 48															
						1	n D	36.5347	52.04	+19	52 23							52.34	+19	5552 53
2	n B	54.0493	5553.05	+25	5553.30	2	n B	36.5012	53.86	+19	54.05							54.16	+19	5554.35
2	n D	54.0828	5554 91	+25	5555.16	1	n D	36.4658	55.79	+19	55 98							56.09	+19	5556.28
2	n D	54 2013	5561.50	+24	5561.71	1	n D	36.3487	62.19	+19	62.38		nn D	56.5818	61 51	+ 2	61.53	61.96	+18	5562 15
2	n B	54 2402	5563.38	+24	5563.62	2	n B	36.3119	64.21	+19	64.40							64.51	+19	5564 70
2	n D	54.2845	5566.15	+24	5566.39	1	n D	36.2720	66.40	+18	66 58							66.69	+19	5566.88
1	n D	54.3385	5569.18	+23	5569.41	1	n D	36.2124	69 68	+18	69.86							69.97	+19	5570.16
2	n B	54.3637	5570 60	+23	5570.83															
1	n D	54.3895	5572.05	+23	5572.28															
						1	D?	36.1160	73.40	+18	73.58							73 69	+19	5573.9
2	wn D	54 4591	5575.98	+23	5576.21															
10	wn D	54.5790	5582.76	+22	5582.98	9	D	35.9638	83 47	+17	83.64	9	n D	56.9691	83 37	+ 2	83.39	83 52	+19	5583.71
	Head	54.6151	5584 81	+22	5585.03															
5	B	54.6373	5586 08	+22	5586.30	5	B	35.9097	86.49	+17	86 66							86.77	+19	5586 96
1	n D	54.6735	5588.14	+21	5588.35	1	D	35.8810	88.09	+17	88.26		nn D	57 0788	89 63	+ 2	89.65	88.95	+19	5589.14
7	n B	54.7220	5590.91	+21	5591.12													91.1±		5591.3±
						1	n B	35.8063	92.28	+17	92 45		nn B	57.1241	92.23	+ 2	92 25	92.35	+19	5592 54
	nn D	54.7591	5593.03	+21	5593.24															
						1	n D	35 7768	93 94	+16	94.10							94.21	+19	5594.40
9	n B	54 8125	5596 09	+21	5596.30	4	n B	35.7230	96.96	+16	97.12	3	n B	57 2174	97.59	+ 2	97 61	97.37	+19	5597.56
						1	n D	35.6807	99.35	+16	99.51							99 62	+19	5599.81
	wn D	55.0273	5608.48	+20	5608.68		wn D	35 5058	09.27	+15	09.42		wn D	57.4265	09 68	+ 2	09.70	09.56	+19	5609.75
							from	35 4810	10.60	+15	10.75							10.86	+19	5611 1
2	n B	55.1672	5616.61	+18	5616.79	B		35.3707	16 98	+14	17.12							17 23	+19	5617.42
							to	35 3520	18.00	+14	18.14							18.25	+19	5618.4
	nn D	55.2195	5619.66	+18	5619 84		nn D	35.3203	19.87	+14	20.01							20.12	+19	5620 31
5	n D?	55.2917	5623 89	+18	5624.07		nn D	35.2440	24 25	+13	24.38							24.49	+19	5624.68
	from	55.3220	5625.66	+18	5625.84															
						1	n B	35.1907	27 33	+13	27 46							27 57	+19	5627.76
B	Max	55.3865	5629.47	+17	5629.64	1	n B	35.1425	30 11	+13	30.24							30 35	+19	5630.54
	to	55.4080	5630.70	+17	5630 87															
10	w D	55.4513	5633.29	+17	5633.46	10	w D	35.0832	33 55	+12	33.67	10	n D	57.8438	34.17	0	34 17	33 92	+19	5634 11
	Head	55.4925	5635.73	+17	5635 90		Head	35 0335	36 44	+12	36.56		Head	57 8971	37 32	0	37.32	36 94	+19	5637.13
							B to	34 9390	41 90	+11	42.01							42.12	+19	5642.3
						1	n D	34 9152	43.33	+11	43.44							43 55	+19	5643.74
							from	34.8910	44.70	+11	44 81							44 92	+19	5645 1
						B	Max	34.7160	55 03	+ 9	55.12							55 23	+19	5655.42
							to	34.7010	56.01	+ 9	56.10							56.21	+19	5656.4
	nn D	56.0603	5669.80	+14	5669.91															
						1	n D	34.4457	71.07	+ 7	71 14							71.25	+19	5671.44
	nn B	56.1088	5672.75	+14	5672.89	4	n B	34 4115	73.12	+ 7	73.19							73.40	+19	5673 59
	nn D	56.1550	5675.57	+13	5675.70	1	n D	34.3632	76.01	+ 6	76.07							76.57	+19	5676 76
	nn D	56.3095	5685.04	+13	5685.17															
						1	D	34 1700	87 60	+ 5	87.65							87.76	+19	5688.0
	nn B	56.4272	5692.30	+12	5692.42		wn B	34.0728	93.55	+ 4	93.59							93.70	+19	5693.89
						1	n D	34.0185	96.85	+ 3	96 88		nn D	58.8840	97.30	− 8	97.22	97.05	+19	5697.24
	nn B	56.6180	5704.17	+11	5704.28															
						5	n B	33.8839	05.08	+ 2	05 10		nn B	59.0153	05.44	− 8	05.36	05.23	+19	5705.42
	nn D	56.6618	5706.90	+11	5707 01	4	n D	33.8359	08.03	+ 1	08 04		nn D	59.0651	08.56	− 8	08.48	08 26	+19	5708 45
						2	n B	33.7957	10.50	+ 1	10.51							10.62	+19	5710.81
	nn D	56.7415	5711.90	+11	5712.01	2	n D	33.7610	12.64	0	12 64							12.75	+19	5712 94
						B	from	33.7360	14.20	0	14.20							14.31	+19	5714.5
							to	33.6430	19.90	− 1	19 89							20.00	+19	5720.2
	nn D	56 8735	5720 22	+10	5720 32	1	n D	33.6153	21 66	− 1	21 65							21 76	+19	5721.95
	nn B	56.9211	5723.23	+10	5723.33	4	n B	33.5777	23.99	− 2	23.97							24 08	+19	5724.27
3	n D	57.0325	5730.31	+10	5730.41		wn D	33.4608	31.29	− 3	31 26	3-4	nn D	59 4391	31 61	−10	31.51	31.32	+19	5731.51
							from	33.4250	33.51	− 3	33.48							33.59	+19	5733.8
						Con.	to	33.2990	41.44	− 5	41.39							41.50	+19	5741.7
						Spec.	nn D	33.2642	43.64	− 5	43.59							43.70	+19	5743.89
	wn D	57.2991	5747.40	+ 8	5747.48															
							nn D	33.1718	49.49	− 6	49.43							49.54	+19	5749.73
						Max	B	33.0560	56.86	− 8	56.78							56.89	+19	5757.08
	nn D	57.5171	5761.54	+ 8	5761.62		nn D	32.9707	62.31	− 8	62 23							62 34	+19	5762.53
							nn D	32.8330	71.15	−10	71.05							71 16	+19	5771.35
						1	n D	32.7225	78.29	−11	78.18							78.29	+19	5778.48

318 *BIRMINGHAM*—*Continued*

Plate G 253						Plate G 284						Plate G 379						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
2	n D	57.8585	5783.37	+ 7	5783.44	....	wn D	32.6312	84.22	−11	84.11	....	......	......	.....	....	.....	84.22	+19	5784.41
..	nn D	58.0530	5796.96	+ 6	5797.02	....	......	....	.....	....	....	....	......	......	.....	....	.....	.....	....	....
...	......	....	....	...	....	1	nn D	32.4060	98.90	−13	98.77	....	......	......	.....	....	.....	98.88	+19	5799.1
...	nn D	58.3350	5815.97	+ 5	5816.02	....	......	....	.....	....	....	....	......	......	.....	....	.....	.....	....	....
....	......	....	....	...	....	1	nn D	32.4120	18.40	−14	18.26	....	......	......	.....	....	.....	18.37	+19	5818.5
...	nn D	58.4216	5821.87	+ 5	5821.92	....	......	....	.....	....	....	....	......	......	.....	....	.....	.....	....	....
....	nn D	58.5381	5829.83	+ 5	5829.88	....	......	....	.....	....	....	....	......	......	.....	....	.....	.....	....	....
....	nn D	58.5988	5834.07	+ 4	5834.11	....	......	....	.....	....	....	....	......	......	.....	....	.....	.....	....	....
....	nn D	58.6518	5837.66	+ 4	5837.70	....	......	....	.....	....	....	....	......	......	.....	....	.....	.....	....	....
....	......	....	....	...	....	1	n D	31.6693	48.31	−15	48.16	....	......	......	.....	....	.....	48.27	+19	5848.46
	End	59.0350	5864.30	+ 4	5864.34	....	......	....	....	....	....	....	......	......	.....	....	.....	.....	....	5864.

74 *SCHJELLERUP*

Plate G 383 1900, February 1, G.M.T. 17h3. Hour angle, W 1h8 Star fair; comparison fair						Plate G 391 1900, March 7, G.M.T. 15h5. Hour angle, W 2h3 Star fair; comparison fair						Wave-Length from G 391 only		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	wn D	58.2020	4395.10	−21	4394.89	...	wn D	60.4865	4395.64	−51	4395.13	95.13	− 7	4395.06
...	....	....	....	....	....	...	wn D	60.1810	4401.30	−51	4400.79	00.79	− 7	4400.72
2-3	n B	57.7867	4402.86	−22	4402.64	...	B	60.0825	4403.19	−51	4402.68	02.68	− 7	4402.61
...	....	....	....	....	....	Limits		60.1200	4402.40	−51	4401.89	01.89	− 7	4401.8
...	....	....	....	....	....	Limits		60.0290	4404.20	−51	4403.69	03.69	− 7	4403.6
...	....	....	....	....	....	...	nn D	59.9480	4405.70	−51	4405.19	05.19	− 7	4405.12
...	nn D	57.4610	4409.00	−24	4408.76	...	wn D	59.7610	4409.20	−52	4408.68	08.68	− 7	4408.61
...	nn D	57.1240	4415.40	−25	4415.15	...	nn D	59.4130	4415.90	−52	4415.38	15.38	− 7	4415.31
...	nn D	56.4610	4428.10	−28	4427.82	3	nn D	58.7620	4428.40	−52	4427.88	27.88	− 7	4427.81
...	....	....	....	....	....	...	nn D	58.6370	4431.01	−52	4430.49	30.49	− 7	4430.42
...	wn D	56.0640	4435.90	−28	4435.62	...	wn D	58.3620	4436.31	−52	4435.79	35.79	− 7	4435.72
...	....	....	....	....	....	5	n B	57.7010	4449.46	−51	4448.95	48.95	− 7	4448.88
...	nn D	55.3284	4450.50	−30	4450.20	...	wn D	57.6272	4450.94	−51	4450.43	50.43	− 8	4450.35
...	....	....	....	....	....	...	nn D	57.3560	4456.40	−51	4455.89	55.89	− 8	4455.81
...	....	....	....	....	....	...	nn D	57.1490	4460.60	−51	4460.09	60.09	− 8	4460.01
...	....	....	....	....	....	...	nn D	57.0296	4463.07	−51	4462.56	62.56	− 8	4462.48
...	....	....	....	....	....	B	from	56.9990	4463.70	−51	4463.19	63.19	− 8	4463.1
...	wn B	54.6426	4464.39	−31	4464.08	B	....	....	....	....	....	......	....	....
...	....	....	....	....	....	B	to	56.9140	4465.40	−51	4464.89	64.89	− 8	4464.8
...	nn D	54.2796	4471.86	−32	4471.54	...	....	....	....	....	....	......	....	....
...	....	....	....	....	....	Max	B	56.4620	4474.80	−50	4474.30	74.30	− 8	4474.2
...	....	....	....	....	....	1	nn D	56.4000	4476.00	−50	4475.50	75.50	− 8	4475.42
Max	B	53.9170	4479.40	−32	4479.08	...	....	....	....	....	....	......	....	....
...	....	....	....	....	....	1	nn D	56.1746	4480.80	−50	4480.30	80.30	− 8	4480.22
...	....	....	....	....	....	1	nn D	56.0743	4482.91	−49	4482.42	82.42	− 8	4482.34
Max	B	53.6900	4484.20	−33	4483.87	...	....	....	....	....	....	......	....	....
...	....	....	....	....	....	1-2	nn D	55.8246	4488.18	−49	4487.69	87.69	− 8	4487.61
...	....	....	....	....	....	1	n D	55.7099	4490.62	−49	4490.13	90.13	− 8	4490.05
...	wn D	53.0780	4497.20	−33	4496.87	2	n D	55.3752	4497.77	−48	4497.29	97.29	− 8	4497.21
...	....	....	....	....	....	1-2	nn D	55.1543	4502.53	−48	4502.05	02.05	− 8	4501.97
B	from	52.8140	4502.80	−33	4502.47	B	from	55.1250	4503.10	−47	4502.63	02.63	− 8	4502.5
B	to	52.6540	4506.30	−33	4505.97	B	to	54.9540	4506.80	−47	4506.33	06.33	− 8	4506.3
...	....	....	....	....	....	2-3	nn D	54.9215	4507.59	−47	4507.12	07.12	− 8	4507.04
...	....	....	....	....	....	1	nn D	54.7896	4510.46	−47	4509.99	09.99	− 8	4509.91
...	....	....	....	....	....	..	nn D	54.6760	4512.90	−47	4512.43	12.43	− 8	4512.4
...	....	....	....	....	....	1	nn B	54.4351	4518.25	−46	4517.79	17.79	− 8	4517.71
...	....	....	....	....	....	1-2	n D	54.4082	4518.92	−46	4518.46	18.46	− 8	4518.38
...	....	....	....	....	....	8	n B	54.2459	4522.45	−46	4521.99	21.99	− 8	4521.91

74 *SCHJELLERUP—Continued*

Plate G 383						Plate G 391						Wave-Length from G 391 only		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
1	nn D	51.8680	4523.57	−32	4523.25	2	nn D	54.1879	4523.73	−45	4523.28	23.28	− 8	4523.20
...	....	....	....	....	....	0	nn D	54.0010	4527.90	−45	4527.45	27.45	− 8	4527.4
1	D	51.6014	4529.52	−32	4529.20	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	1	nn D	53.8414	4531.48	−44	4531.04	31.04	− 8	4530.96
...	....	....	....	....	....	...	nn D	53.6220	4536.40	−44	4535.96	35.96	− 8	4535.9
B	from	51.2760	4536.90	−31	4536.59	B	from	53.5910	4537.10	−44	4536.66	36.66	− 8	4536.6
	to	51.1430	4539.90	−31	4539.59		to	53.4450	4540.40	−44	4539.96	39.96	− 8	4539.9
...	....	....	....	....	....	1-2	nn D	53.4177	4541.08	−43	4540.65	40.65	− 8	4540.57
...	....	....	....	....	....	B	from	53.1430	4547.30	−43	4546.87	46.87	− 8	4546.8
Max	B	50.7896	4547.94	−30	4547.64		....	....	....	....	....	.....	....	....
...	....	....	....	....	....		to	53.0720	4549.00	−42	4548.58	48.58	− 8	4548.5
...	nn D	50.5253	4554.04	−29	4553.75	...	w D	52.8309	4554.56	−41	4551.15	54.15	− 8	4554.07
...	....	....	....	....	....	B	from	52.7730	4555.90	−41	4555.49	55.49	− 8	4555.4
Max	B	50.3232	4558.74	−29	4558.45		....	....	....	....	....	.....	....	....
...	....	....	....	....	....		to	52.5770	4560.40	−41	4559.99	59.99	− 8	4559.9
...	....	....	....	....	....	...	nn D	52.5555	4560.97	−41	4560 56	60.56	− 8	4560.48
...	....	....	....	....	....	...	nn D	52.4284	4563.95	−40	4563.55	63.55	− 8	4563.47
...	....	....	....	....	....	1	n D	52.3319	4566.22	−40	4565.82	65.82	− 8	4565.74
...	wn D	49.7528	4572.14	−27	4571.87	...	nn D	52.0960	4571.80	−39	4571.41	71.41	− 8	4571.3
2	n D	49.5500	4576.97	−26	4576.71	...	nn D	51.8300	4578.10	−37	4577.73	77.73	− 8	4577.7
...	....	....	....	....	....	...	nn D	51.2670	4591.70	−35	4591.35	91.35	− 8	4591.3
...	....	....	....	....	....	...	nn D	51.1280	4595.12	−35	4594.77	94.77	− 8	4594.69
...	....	....	....	....	....	4	n B	51.0594	4596.78	−35	4596.43	96.23	− 8	4596.15
...	....	....	....	....	....	2	n B	50.9218	4600.17	−34	4599.83	99.83	− 8	4599.75
...	....	....	....	....	....	1	n D	50.8759	4601.29	−34	4600.95	00.95	− 8	4600.86
...	....	....	....	....	....	1	n B	50.8237	4602.58	−34	4602.24	02.24	− 8	4602.16
...	wn D	48.3246	4606.81	−21	4606.60	8	wn D	50.6337	4607 29	−33	4606.96	06.96	− 8	4606.88
...	....	....	....	....	....	5	wn B	50.5428	4609.30	−32	4608.98	08.98	− 8	4608.90
...	....	....	....	....	....	1	n D	50.4861	4610.96	−32	4610.64	10.64	− 8	4610.56
2	nn B	48.1030	4612.30	−20	4612.10	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	2	n D	50.3577	4614.17	−32	4613.85	13.85	− 8	4613.77
2	nn B	47.9930	4615.10	−20	4614.90	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	6	n B	50.3072	4615.43	−32	4615.11	15.11	− 8	4615.03
...	....	....	....	....	....	3	n D	50.2564	4616.71	−32	4616.39	16.39	− 8	4616.31
8	B	47.8800	4617.92	−20	4617.72	10	w B	50.1900	4618.38	−31	4618.07	18.07	− 8	4617.99
...	wn D	47.8031	4619.86	−19	4619.67	3	n D	50.1222	4620.09	−31	4619.78	19.78	− 8	4619.70
Max	B	47.7306	4621.70	−19	4621.51	5	n B	50.0477	4621.97	−31	4621.66	21.66	− 8	4621.58
...	n D	47.6758	4622.08	−19	4621.89	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	1-2	nn D	49.9884	4623.47	−30	4623.17	23.17	− 8	4623.09
...	....	....	....	....	....	B	from	49.9680	4624.00	−30	4623.70	23.70	− 8	4623.6
Max	B	47.6200	4624.50	−18	4624.32		....	....	....	....	....	.....	....	....
Max	B	47.5120	4627.30	−18	4627.12		....	....	....	....	....	.....	....	....
...	....	....	....	....	....		to	49.7970	4628.30	−30	4628.00	28.00	− 8	4627.9
...	....	....	....	....	....	6-8	nn D	49.7519	4629.49	−29	4629.20	29.20	− 8	4629.12
Max	B	47.3525	4631.32	−18	4631.14	9	n B	49.6712	4631.55	−29	4631.26	31.26	− 8	4631.18
...	....	....	....	....	....	1	nn D	49.5357	4635.00	−29	4634.71	34.71	− 8	4634.63
...	....	....	....	....	....	1	nn D	49.4289	4637.78	−29	4637.49	37.49	− 8	4637.41
5	nn B	47.0662	4638.69	−17	4638.52	7	B	49.3664	4639.39	−28	4639.11	39.11	− 8	4639.03
...	nn D	47.0072	4640.22	−17	4640.05	5	D	49.3100	4641.12	−28	4640.84	40.84	− 8	4640.76
7	wn B	46.9237	4642.38	−17	4642.21	10	B	49.2399	4642.67	−28	4642.39	42.39	− 8	4642.31
...	....	....	....	....	....	Limits		49.2850	4641.50	−28	4641.22	41.22	− 8	4641.1
...	....	....	....	....	....	Limits		49.2030	4643.60	−28	4643.32	43.32	− 8	4643.2
...	wn D	46.7670	4646.50	−16	4646.34	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	1	nn B	48.8300	4653.40	−27	4653.13	53.13	− 8	4653.05
...	wn B	46.3860	4656.50	−16	4656.34	...	....	....	....	....	....	.....	....	....
...	wn B	46.0320	4665.90	−15	4665.75	1-2	n B	48.3704	4665.57	−25	4665.32	65.32	− 8	4665.24
D	from	44.3100	4713.30	−20	4713.10	...	....	....	....	....	....	.....	....	....
	....	....	....	....	....	...	wn D	46.5664	4715.22	−21	4715.01	15.01	− 8	4714.93
	to	44.1910	4716.70	−20	4716.50	...	....	....	....	....	....	.....	....	....
B	from	44.1910	4716.70	−20	4716.50	...	....	....	....	....	....	.....	....	....
	....	....	....	....	....	1-2	n B	46.3751	4720.67	−21	4720.46	20.46	− 8	4720.38
	to	44.0200	4721.60	−21	4721.39	...	....	....	....	....	....	.....	....	....
...	nn D	43.9790	4722.80	−21	4722.59	1	n D	46.2887	4723.14	−21	4722.93	22.93	− 8	4722.85
...	....	....	....	....	....	1	nn D	46.0890	4728.80	−20	4728.60	28.60	− 8	4728.52
...	nn D	43.7280	4730.00	−23	4729.77	...	....	....	....	....	....	.....	....	....

74 SCHJELLERUP — Continued

Plate G 383						Plate G 391						Wave-Length from G 391 only		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
D {	from	43 5160	4735.30	−24	4735.06	D {	from	45.8880	4734.60	−20	4734.40	34.39	− 8	4734.3
	to	43.4640	4737.70	−24	4737.46		to	45.7790	4737.87	−20	4737.67	37.67	− 8	4737.6
10	wn D	43 5025	4736.56	−24	4736.32	...	....	....	....	....	....	.....	....	....
10	nn B	43.4117	4739.21	−25	1738.96	10	B	45.7409	4738.97	−20	4738.77	38.77	− 8	4738.69
...	....	....	....	....	....	Con. {	from	45.7070	4739.90	−20	4739.70	39.70	− 8	4739.6
...	....	....	....	....	....	Spec.	to	45.6230	4742.40	−20	4742.20	42.20	− 8	4742.1
...	nn D	43.2249	4744.69	−26	4744.43	...	D	45.5649	4741.12	−20	4743.92·	43.92	− 8	4743.84
...	....	....	....	....	....	tts. {	from	45.6178	4742.56	−20	4742.36	42 36	− 8	4742.3
...	....	....	....	....	....		to	45.5043	4745.90	−19	4715.71	45.71	− 8	4745.6
...	....	....	....	....	....	B {	from	45.5013	4745 90	−19	4745.71	45.71	− 8	4745.6
...	....	....	....	....	....		to	45.4030	4748.90	−19	4748.71	48.71	− 8	4748.6
...	....	....	....	....	....	...	nn D	45.3820	4749.50	−19	4719.31	49.31	− 8	4749.23
...	....	....	....	....	....	B {	f.om	45.2410	4753.60	−19	4753.41	53.41	− 8	4753.3
...	....	....	....	....	....		to	45.0980	4757.90	−19	4757.71	57.71	− 8	4757.6
...	nn D	42.7371	4759.18	−29	4758.89	3 4	nn D	45.0587	4759.10	−19	4758.91	58.91	− 8	4758.83
...	....	....	....	....	....	B {	from	45.0150	4760.40	−19	4760.21	60.21	− 8	4760.1
...	....	....	....	....	....		to	44.8240	4766.10	−19	4765.91	65.91	− 8	4765.8
...	....	....	....	....	....	...	nn D	44.8089	4766.60	−19	4766.41	66.41	− 8	4766.33
...	....	....	....	....	....	B {	from	44.7800	4767.40	−19	4767.21	67.21	− 8	4767.1
...	....	....	....	....	....		to	44.6150	4772.40	−19	4772.21	72.21	− 8	4772.1
...	nn D	42.2610	4773.60	−32	4773.28	...	nn D	44.5834	4773.42	−19	4773.23	73.23	− 8	4773.15
...	....	....	....	...	....	B {	from	44.5570	4774.20	−19	4774.01	74.01	− 8	4773.9
...	....	....	....	....	....		to	44.4160	4778.50	−19	4778.31	78.31	− 8	4778.2
1	nn D	41.8912	4784.90	−31	4781.56	1-2	nn D	44.2150	4784.70	−19	4784.51	84.51	− 8	4784.43
2	nn D	41.7176	4790.28	−36	4789.92	2	n D	44.0579	4789.53	−19	4789.34	89.34	− 8	4789.26
B {	from	41.6890	4791.20	−36	4790.84	B {	from	44.0290	4790.40	−19	4790.21	90.21	− 8	4790.1
	to	....	....	....	....		to	43.8300	4796.61	−19	4796.42	96.42	− 8	4796.3
...	....	....	....	....	....	8	n B	43.6348	4802.71	−19	4802.52	02.52	− 8	4802.44
...	....	....	....	....	....	...	n D	43.4940	4807.10	−20	4806.90	06.90	− 8	4806.82
...	....	....	....	....	....	...	n D	43.3270	4812.40	−20	4812.20	12.20	− 8	4812.12

74 SCHJELLERUP

Plate G 373 1900, January 7, G.M.T. 15h0. Hour angle, E 2h1 Star good; comparison good						Plate G 386 1900, February 16, G.M.T. 14h8. Hour angle, W 0h3 Star poor; comparison fair						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
3	n D	49.4320	5173.44	−16	5173.28	3 4	D	45.1046	5173.79	−48	5173 31	73.30	− 9	5173.21
D {	from	49.2160	5182.20	−17	5182.03	...	....	....	....	....	....	81.83	− 9	5181.7
	......	....	....	....	....	...	D?	44.8410	5181.50	−50	5184 00	84.20	− 9	5184.11
	to	49.1240	5186.00	−17	5185.83	...	....	....	....	...	....	85.63	− 9	5185.5
Con. {	from	49.1240	5186.00	−17	5185.83	...	....	....	....	...	....	85.63	− 9	5185.5
	......	....	....	....	....	...	D?	44.7210	5189.50	−50	5189.00	89.20	− 9	5189.11
Spec.	to	48.9780	5191.90	−17	5191.73	...	....	....	....	...	....	91.53	− 9	5191.4
4	D	48.9144	5193.32	−18	5193.14	...	D??	44.6200	5193.60	−51	5193.09	93.12	− 9	5193.03
Max	B	48.8394	5197.65	−18	5197.47	...	....	....	....	....	....	97.27	− 9	5197.18
D {	from	48.6610	5205.10	−19	5204.91	...	....	....	....	...	....	04.71	− 9	5204.6
	......	....	....	....	....	...	D??	44 2120	5210.60	−52	5210.08	10.28	− 9	5210.19
	to	48.5040	5211.60	−19	5211.41	...	....	....	....	....	....	11.21	− 9	5211.1
B {	from	48.4780	5212.70	−19	5212.51	...	....	....	....	....	....	12.31	− 9	5212.2
	......	....	....	....	....	...	D??	44.0580	52.1700	−53	5216 17	16.67	− 9	5216.58
	to	48.1930	5224.70	−20	5224.50	...	....	....	....	...	....	21.30	− 9	5221.2
6-8	w D	48.1469	5226.66	−20	5226.46	...	wn D	43.8320	5226.60	−54	5226 06	26.26	− 9	5226.17
B {	from	48.0860	5229.30	−20	5229.40	...	...	....	....	...	....	28.90	− 9	5228.8
	to	47.9820	5233.78	−20	5233.58	...	....	....	....	....	....	33.38	− 9	5233.3

74 *SCHJELLERUP — Continued*

Plate G 373						Plate G 386						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
2	n D	47.9641	5234.44	−20	5234.24	...	D?	43.6420	5234.70	−55	5234.15	34.04	−9	5233.95
2	n B	47.8913	5237.56	−21	5237.35	...	....	....	....	....	....	37.15	−9	5237.06
...	nn D	47.8283	5240.27	−21	5240.06	...	D?	43.4970	5240.90	−55	5240.35	40.21	−9	5240.12
2 3	nn B	47.7130	5245.30	−21	5245.09	...	....	....	....	....	....	44.89	−9	5244.80
3	n D	47.6561	5247.69	−21	5247.48	...	D?	43.3360	5247.90	−56	5247.34	47.41	−9	5247.32
2	n D	47.5628	5252.17	−21	5251.96	...	D?	43.2400	5252.10	−56	5251.54	51.75	−9	5251.66
3	wn D	47.1322	5270.59	−22	5270.37	...	wn D	42.8150	5270.70	−56	5270.14	70.26	−9	5270.17
1	n D	46.8311	5284.42	−22	5284.20	...	....	....	....	....	....	84.00	−9	5283.91
3	nn D	46.5147	5298.21	−22	5297.99	...	....	....	....	....	....	97.79	−9	5297.70
1–2	n D	46.4096	5302.98	−22	5302.76	...	....	....	....	....	....	02.56	−9	5302.47
1	nn D	46.3064	5307.68	−22	5307.46	...	....	....	....	....	....	07.26	−9	5307.17
1	n D	46.1307	5315.73	−22	5315.51	1 2	n D	41.8151	5315.81	−55	5315.26	15.39	−9	5315.30
8	n B	46.0765	5318.22	−22	5318.00	1	B	41.7738	5317.72	−54	5317.18	17.59	−9	5317.50
...	....	....	....	....	....	1–2	n D	41.7014	5321.06	−54	5320.52	20.72	−9	5320.63
2–3	n D	45.8363	5329.34	−21	5329.13	2	n D	41.5178	5329.59	−54	5329.05	29.09	−9	5329.00
2	nn D	45.6677	5337.22	−21	5337.01	...	nn D	41.3590	5337.00	−53	5336.47	36.74	−9	5336.65
4	n B	45.6254	5339.20	−21	5338.99	...	....	....	....	....	....	38.79	−9	5338.70
2	n D	45.5680	5341.90	−21	5341.69	1–2	n D	41.2588	5341.72	−53	5341.19	41.44	−9	5341.35
2	n D	45.3895	5350.32	−20	5350.12	...	....	....	....	....	....	49.92	−9	5349.83
...	....	....	....	....	....	...	nn D	40.8260	5362.30	−52	5361.78	61.98	−9	5361.89
1	n D	45.0436	5366.84	−19	5366.65	...	....	....	....	....	....	66.45	−10	5366.35
5	D	44.9377	5371.94	−19	5371.75	6	wn D	40.6243	5372.00	−51	5371.49	71.62	−10	5371.52
8	n B	44.8721	5375.11	−19	5374.92	2	nn B	40.5560	5375.30	−51	5374.79	74.86	−10	5374.76
2	n D	44.8173	5377.77	−19	5377.58	2	nn D	40.5028	5377.89	−51	5377.38	77.48	−10	5377.38
6	n B	44.7632	5380.39	−18	5380.21	...	....	....	....	....	....	80.01	−10	5379.91
...	....	....	....	....	....	...	nn D	40.3560	5385.10	−51	5384.59	84.79	−10	5384.69
3	n B	44.4953	5393.49	−18	5393.31	...	....	....	....	....	....	93.11	−10	5393.01
3	D	44.4056	5397.92	−17	5397.75	2	n D	40.1023	5397.51	−50	5397.01	97.38	−10	5397.28
B	from	44.3790	5399.30	−17	5399.13	...	....	....	....	....	....	98.93	−10	5398.8
	to	44.2480	5405.80	−17	5405.63	...	....	....	....	....	....	05.43	−10	5405.3
1	n D	44.2273	5406.75	−17	5406.58	...	....	....	....	....	....	06.38	−10	5406.28
3–4	n D	44.1450	5410.85	−16	5410.69	1 2	n D	39.8383	5410.62	−49	5410.13	10.41	−10	5410.31
1	n B	44.1064	5412.78	−16	5412.62	...	....	....	....	....	....	12.42	−10	5412.32
6	B	44.0135	5417.43	−16	5417.27	2 3	n B	39.7022	5417.44	−49	5416.95	17.11	−10	5417.01
3	n D	43.9562	5420.31	−16	5420.15	3 4	n D	39.6523	5419.95	−49	5419.36	19.76	−10	5419.66
2–3	n B	43.8945	5423.42	−15	5423.27	...	....	....	....	....	....	23.07	−10	5422.97
2	n B	43.8128	5427.54	−15	5427.39	...	....	....	....	....	....	27.19	−10	5427.09
3-4	n D	43.7561	5430.42	−15	5430.27	3	n D	39.4508	5430.14	−48	5429.66	29.97	−10	5429.87
1	n B	43.7176	5432.59	−15	5432.44	...	....	....	....	....	....	32.24	−10	5432.14
2	nn D	43.6727	5434.66	−15	5434.51	1–2	n D	39.3618	5434.67	−48	5434.19	34.35	−10	5434.25
...	....	....	....	....	....	1	n D	39.2880	5438.44	−48	5437.96	38.16	−10	5438.06
B	from	43.5690	5439.00	−15	5438.85	...	....	....	....	....	....	38.65	−10	5438.55
	to	43.4420	5446.50	−14	5446.36	...	....	....	....	....	....	46.16	−10	5446.06
6	n D	43.4057	5448.34	−14	5448.20	5	n D	39.0952	5448.34	−47	5447.87	48.04	−10	5447.94
2	n D	43.2348	5457.16	−14	5457.02	2–3	n D	38.9332	5456.73	−47	5456.26	56.64	−10	5456.54
1–2	B	43.1981	5459.07	−14	5458.93	...	....	....	....	....	....	58.73	−10	5458.63
1	n D	43.1647	5460.81	−14	5460.67	2	D	38.8511	5460.98	−47	5460.51	60.59	−10	5460.49
B	from	43.1480	5461.80	−14	5461.66	...	....	....	....	....	....	61.46	−10	5461.4
	to	43.0650	5466.60	−14	5466.46	...	....	....	....	....	....	66.26	−10	5466.2
1	n D	43.0384	5467.40	−14	5467.26	...	wn D	38.7040	5468.70	−47	5468.23	67.75	−10	5467.6
3	n B	42.9469	5472.20	−13	5472.07	1	n B	38.6393	5472.08	−47	5471.61	71.87	−10	5471.77
2	nn D	42.8981	5474.76	−13	5474.63	...	....	....	....	....	....	74.43	−10	5474.33
1	n D	42.8307	5478.32	−13	5478.19	...	....	....	....	....	....	77.99	−10	5477.89
4	n B	42.7858	5480.68	−13	5480.55	...	....	....	....	....	....	80.35	−10	5480.25
1	nn D	42.7422	5483.00	−13	5482.87	1 2	nn D	38.4319	5483.03	−46	5482.57	82.74	−10	5482.64
...	....	....	....	....	....	1	n D	38.2764	5491.31	−46	5490.85	91.05	−10	5490.95
3	n D	42.4573	5498.19	−13	5498.06	2	n D	38.1497	5498.10	−46	5497.64	97.85	−10	5497.75
2	n D	42.3813	5502.28	−13	5502.15	2	n D	38.0748	5502.13	−46	5501.67	01.91	−10	5501.81
1	n D	42.2922	5507.08	−12	5506.96	...	....	....	....	....	....	06.76	−10	5506.66
2	n B	42.2556	5509.06	−12	5508.94	...	....	....	....	....	....	08.74	−10	5508.64
1	nn D	42.1895	5512.64	−12	5512.52	2	nn D	37.8800	5512.70	−46	5512.24	12.38	−10	5512.28
...	wn D	41.9690	5524.68	−12	5524.56	1	n D	37.6637	5524.48	−46	5524.02	24.29	−10	5524.19
2	n B	41.8372	5531.92	−12	5531.80	...	....	....	....	....	....	31.60	−10	5531.50
1	n D	41.8017	5533.88	−12	5533.76	...	....	....	....	....	....	33.76	−10	5533.66
8	wn D	41.6950	5539.79	−12	5539.67	8	wn D	37.3918	5539.49	−46	5539.03	39.35	−10	5539.25

74 *SCHJELLERUP—Continued*

Plate G 373						Plate G 386						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		mm.			mm.	t.m.		t.m.	t.m.		t.m.
Max	B	41.6172	5544.11	−12	5543.99	1–2	nn B	37.3140	5543.80	−46	5543.34	43.67	−10	5543.57
1	nn D	41.4658	5552.62	−12	5552.50	...	....	....	....	....	....	52.30	−10	5552.20
1	n B	41.4334	5554.39	−12	5554.27	1	B	37.1284	5554.21	−46	5553.75	54.01	−10	5553.91
1	n D	41.4009	5556.22	−12	5556.10	...	....	....	....	....	....	55.90	−10	5555.80
1–2	B	41.2419	5565.19	−13	5565.06	1	B	36.9359	5565.07	−46	5564.61	64.83	−10	5564.73
1	wn D	41.2081	5567.10	−13	5566.97	2	n D	36.9050	5566.82	−46	5566.36	66.67	−10	5566.57
0–1	nn D	41.1502	5570.39	−13	5570.26	...	....	....	....	....	....	70.06	−10	5569.96
...	....	....	....	....	....	1	D	36.7830	5573.77	−46	5573.31	73.51	−10	5573.41
9	D	40.9025	5584.55	−13	5584.42	9	w D	36.6009	5584.20	−46	5583.74	84.08	−10	5583.98
4	B	40.8559	5587.24	−13	5587.11	3	n B	36.5467	5587.32	−46	5586.86	86.99	−10	5586.89
1	n D	40.8231	5589.13	−13	5589.00	1	n D	36.5076	5589.58	−46	5589.14	89.07	−10	5588.97
1	n D	40.7252	5594.79	−13	5594.66	1	nn D	36.4099	5595.24	−46	5594.78	94.72	−10	5594.62
3	n B	40.6685	5598.08	−14	5597.94	4	wn B	36.3717	5597.45	−46	5596.99	97.47	−10	5597.37
1	nn D	40.6351	5600.02	−14	5599.88	...	...	....	....	....	....	99.68	−10	5599.58
2	nn D	40.4658	5609.91	−14	5609.77	1	n D	36.1591	5609.88	−47	5609.41	09.59	−10	5609.49
...	....	....	....	....	....	D	from	36.0070	5618.90	−47	5618.43	18.63	−10	5618.5
...	....	....	....	....	....		to	35.8770	5626.50	−48	5626.02	26.22	−10	5626.1
3	n D	40.2844	5620.60	−15	5620.45	3–4	nn D	35.9767	5620.63	−48	5620.15	20.30	−10	5620.20
4	wn D	40.2078	5625.13	−15	5624.98	5	nn D	35.8986	5625.26	−48	5624.78	24.88	−10	5624.78
B	from	40.1750	5627.09	−15	5626.94	Con. Spec.	from	35.8710	5626.90	−48	5626.42	26.68	−10	5626.6
	to	40.0810	5632.70	−15	5632.55		to	35.7790	5632.40	−48	5631.92	32.24	−10	5632.1
10	w D	40.0467	5634.73	−15	5634.58	10	wn D	35.7436	5634.50	−48	5634.02	34.30	−10	5634.20
Head		40.0051	5637.22	−16	5637.06	Head		35.7024	5636.97	−48	5636.49	36.78	−10	5636.68
...	....	....	....	....	....	2	n B	35.6791	5638.37	−48	5637.89	38.09	−10	5637.99
...	....	....	....	....	....	1	n D	35.6555	5639.79	−48	5639.31	39.51	−10	5639.41
...	....	....	....	....	....	2	n B	35.6234	5641.71	−48	5641.23	41.43	−10	5641.33
2	n D	39.8922	5644.00	−16	5643.84	2	n D	35.5812	5644.25	−48	5643.77	43.81	−10	5643.71
B	from	39.8720	5645.30	−16	5645.14	...	....	....	....	....	....	44.94	−10	5644.84
	....	....	....	....	....	1	nn D	35.4822	5650.24	−49	5649.75	49.95	−10	5649.85
	to	39.6670	5657.64	−17	5657.47	...	....	....	....	....	....	57.27	−10	5657.2
1	n D	39.6549	5658.37	−17	5658.20	3	n D	35.3383	5658.98	−49	5658.49	58.35	−10	5658.25
...	....	....	....	....	....	4	wn D	35.1314	5671.66	−50	5671.16	71.36	−10	5671.26
2	B	39.3863	5674.83	−18	5674.65	...	....	....	....	....	....	74.45	−10	5674.35
2	wn D	39.3469	5677.29	−18	5677.11	2	n D	35.0436	5677.07	−50	5676.57	76.84	−10	5676.74
1	B	39.3071	5679.72	−18	5679.54	...	....	....	....	....	....	79.34	−10	5679.24
1	nn D	39.1803	5687.59	−19	5687.40	1	nn D	34.8822	5687.09	−51	5686.58	86.99	−10	5686.89
6	n B	39.0737	5694.25	−19	5694.06	5	n B	34.7734	5693.88	−51	5693.37	93.72	−10	5693.62
0–1	B	38.9700	5700.75	−19	5700.56	...	....	....	....	....	....	00.36	−10	5700.26
2	B	38.8886	5705.88	−20	5705.68	3	n B	34.5880	5705.54	−52	5705.02	05.35	−10	5705.25
2	wn D	38.8399	5708.96	−20	5708.76	2	n D	34.5358	5708.84	−52	5708.32	08.54	−10	5708.44
1	B	38.7990	5711.55	−20	5711.35	...	....	....	....	....	....	11.15	−10	5711.05
2	n D	38.7682	5713.50	−20	5713.30	1	n D	34.4673	5713.18	−52	5712.66	12.98	−10	5712.88
4	wn B	38.6995	5717.87	−20	5717.67	4	wn B	34.4006	5717.43	−53	5716.90	17.29	−10	5717.19
1	n D	38.6360	5721.92	−20	5721.72	2	n D	34.3372	5721.47	−53	5720.91	21.33	−10	5721.23
3	n B	38.5946	5724.57	−20	5724.37	...	....	....	....	....	....	24.17	−10	5724.07
...	....	....	....	....	....	D	from	34.2510	5727.00	−53	5726.47	26.67	−10	5726.6
2	n D	38.4744	5732.28	−22	5732.06		....	....	....	....	....	31.86	−10	5731.76
...	....	....	....	....	....		to	34.1450	5733.80	−54	5733.26	33.46	−10	5733.4
Max	B	38.3920	5737.61	−22	5737.39	...	....	....	....	....	....	37.19	−10	5737.09
1	nn D	38.2860	5744.48	−22	5744.26	...	....	....	....	....	....	44.06	−10	5743.96
1	n D	38.0039	5762.92	−24	5762.68	...	nn D	33.6910	5763.40	−56	5762.84	62.76	−10	5762.66
...	wn D	37.8645	5772.13	−24	5771.89	...	nn D	33.5719	5771.96	−56	5771.40	71.69	−10	5771.59
1	nn D	37.7701	5778.40	−24	5778.16	...	....	....	....	....	....	77.96	−10	5777.86
B	from	37.8770	5774.00	−24	5773.76	...	....	....	....	....	....	73.56	−10	5773.5
	to	37.7090	5782.50	−25	5782.25	...	....	....	....	....	....	82.05	−10	5782.0
D	from	37.7090	5782.50	−25	5782.25	...	....	....	....	....	....	82.05	−10	5782.0
	to	37.5710	5791.80	−25	5791.55	...	....	....	....	....	....	91.35	−10	5791.3
1	nn D	37.4625	5799.05	−25	5798.80	...	....	....	....	....	....	98.60	−10	5798.50
2	n D	37.1044	5823.47	−25	5823.22	...	....	....	....	....	....	23.02	−10	5822.92

78 *SCHJELLERUP*

Plate G 344 1899, October 4, G.M.T. 20h ±. Hour angle, E 3h ± Star good; comparison excellent						Plate G 392 1900, March 21, G.M.T. 18h ±. Hour angle, E 3h ± Star excellent; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	1	nn D	53.6860	4388.20	−40	4387.80	87 60	+ 1	4387.6
...	....	....	....	....	....	2	D	53.5655	4390.41	−40	4390.01	89.81	+ 1	4389.82
...	wn D	61.6970	4395.00	+29	4395.29	8	w D	53.3033	4395.30	−42	4394.88	95.09	+ 1	4395.10
...	wn D	61.4100	4400.40	+28	4400.68	1	nn D	52.9584	4401.77	−44	4401.33	01.13	+ 1	4401.14
2	n B	61.3173	4402.19	+28	4402.47	...	....	....	....	....	....	02.67	+ 1	4402.68
....	nn D	61 1835	4404.75	+27	4405.02	...	nn D	52.7441	4405.82	−45	4405.37	05 20	+ 1	4405.21
...	....	....	....	....	....	3	nn D	52.5560	4409.40	−46	4408.94	08.74	+ 1	4408.75
...	wn D	60.6560	4414.90	+25	4415.15	3	wn D	52.2179	4415.87	−49	4415.38	15.17	+ 1	4415.18
...	nn D	60.3900	4420.10	+24	4420.34	...	....	....	....	....	....	20.54	+ 1	4420.55
...	wn D	60.2660	4422.50	+23	4422.73	...	....	....	....	....	....	22.93	+ 1	4422.94
...	nn D	60.0996	4425.81	+23	4426.04	...	....	....	....	....	....	26.24	+ 1	4426.25
...	nn D	60.0268	4427.25	+22	4427.47	1	nn D	51.5790	4428.28	−52	4427.76	27.62	+ 1	4427.63
...	nn D	59.8865	4430.03	+22	4430.25	1	nn D	51.4412	4430.98	−52	4430.46	30.36	+ 1	4430.37
6	wn D	59.6087	4435.56	+22	4435.78	7	wn D	51.1578	4436.58	−54	4436.04	35.91	+ 1	4435.92
1	nn D	59.4958	4437.82	+21	4438.03	...	....	....	....	....	....	38.13	+ 1	4438.14
2	n B	59.4438	4438.87	+21	4439.08	3	nn B	50.9694	4440.32	−55	4439.77	39.43	+ 1	4439.44
1	nn D	59.2985	4441.80	+21	4442.01	...	....	....	....	....	....	42.21	+ 1	4442.22
2	n D	59.1816	4444.16	+21	4444.37	...	....	....	....	....	....	44.57	+ 1	4444 58
1	nn D	59.0300	4447.24	+21	4447.45	...	....	....	....	....	....	47.65	+ 1	4447.66
2	n B	58.9710	4448.44	+21	4448.65	3	nn B	50.5042	4449.65	−57	4449.08	48.87	+ 1	4448.88
...	nn D	58.9028	4449.83	+20	4450.03	3	n D	50.4299	4451.15	−58	4450.57	50.30	+ 2	4450.32
...	....	....	....	....	....	0–1	nn D	50.2897	4453.99	−58	4453.41	53.21	+ 2	4453.23
1	nn D	58.6457	4455.10	+20	4455.30	2	n D	50.1773	4456.28	−58	4455.70	55 50	+ 2	4455.52
1	nn D	58.5558	4456.95	+20	4457.15	...	....	....	....	....	....	57.35	+ 2	4457.37
1	n D	58.4162	4459.84	+20	4460.04	1	n D	49.9639	4460.64	−59	4460.05	60 05	+ 2	4460.07
...	wn D	58.3197	4461.84	+19	4462.03	2	n D	49.8485	4463.01	−60	4462.41	62.22	+ 2	4462.24
...	....	....	....	....	....	B	from	49.8130	4463.70	−60	4463.10	62.90	+ 2	4462.9
...	n B	58.2285	4463.73	+19	4463.92	3	B	49.7850	4464.32	−60	4463.72	63.82	+ 2	4463.84
...	....	....	....	....	....	2	B	49.7337	4465.40	−61	4464.79	64.59	+ 2	4464.61
...	....	....	....	....	....		to	49.7060	4465.90	−61	4465.29	65.09	+ 2	4465.1
...	....	....	....	....	....	1	n D	49.6959	4466.16	−61	4465.55	65.35	+ 2	4465.37
...	....	....	....	....	....	1	n D	49.5359	4469.48	−62	4468.86	68.66	+ 2	4468.68
2	nn D	57.8730	4471.17	+19	4471.36	...	....	....	....	....	....	71.56	+ 2	4471.58
1	nn D	57.6893	4475.05	+19	4475.24	1	n D	49.2210	4476.00	−63	4475.37	75.31	+ 2	4475.33
...	....	....	....	....	....	1	nn D	48.9834	4481.03	−64	4480.39	80.19	+ 2	4480.21
3	n D	57.3620	4482.00	+19	4482.19	1	nn D	48.8964	4482.87	−64	4482.23	82 21	+ 2	4482.23
...	nn D	57.1250	4487.10	+20	4487.30	1	nn D	48.6291	4488.54	−65	4487.89	87.60	+ 2	4487.62
3	n D	57.0200	4489.35	+20	4489.55	2	nn D	48.5244	4490.78	−65	4490 13	89.84	+ 2	4489.86
3	n D	56.6895	4496.51	+21	4496.72	4	n D	48.1953	4497.84	−66	4497.18	96.95	+ 2	4496 97
...	nn D	56.4587	4501.56	+21	4501.77	1	nn D	47.9757	4502.59	−66	4501.93	01.85	+ 2	4501.87
	from	56.4250	4502.30	+21	4502.51	...	....	....	....	....	....	02.71	+ 2	4502.7
B	....	....	....	....	....	1	nn D	47.8508	4505.31	−67	4504.64	04.44	+ 2	4504.46
	to	56.2640	4506.80	+21	4506.01	...	....	....	....	....	....	06.21	+ 2	4506.2
3–4	nn D	56.2317	4506.56	+22	4506.78	...	wn D	47.7265	4508.03	−67	4507.36	07.07	+ 2	4507.09
	from	56.1860	4507.90	+22	4508.12	...	....	....	....	....	....	08.30	+ 2	4508.3
B	....	....	....	....	....	4	wn B	47.6564	4509.56	−67	4508.89	08.69	+ 2	4508.71
	....	....	....	....	....	1	nn D	47.6052	4510.69	−67	4510.02	09.82	+ 2	4509.84
	to	56.0210	4511.20	+22	4511.42	...	....	....	....	....	....	11.60	+ 2	4511.6
...	nn D	55.9620	4512.53	+22	4512.75	...	wn D	47.4534	4514.03	−67	4513.36	13.06	+ 2	4513.08
1	n B	55.7663	4516 61	+23	4516.84	2	n B	47.2719	4518.04	−67	4517.37	17.11	+ 2	4517.13
2	n D	55.7193	4517.96	+23	4518.19	2–3	n D	47.2758	4519.50	−67	4518.83	18.51	+ 2	4518.53
3	n B	55.5632	4521.47	+23	4521.70	5–6	n B	47.0622	4522.70	−67	4522.03	21.87	+ 2	4521.89
4	n D	55.5050	4522.79	+23	4523.02	4	n D	47.0011	4524.07	−67	4523.40	23.21	+ 2	4523.23
...	....	....	....	....	....		from	46.9620	4524.90	−67	4524.23	24.03	+ 2	4524.1
3–4	n B	55.4268	4524.56	+23	4524.79	B	....	....	....	....	....	24.99	+ 2	4525.01
...	....	....	....	....	....		to	46.8810	4526.80	−67	4526.13	25 93	+ 2	4526.0
...	wn D	55.3178	4527.03	+24	4527.27	...	wn D	46.8047	4528.48	−67	4527.81	27.54	+ 2	4527.56
1	n D	55.1501	4530.84	+24	4531.08	...	nn D	46.6404	4532.18	−67	4531.51	31.30	+ 2	4531.32
	from	55.0640	4532.60	+25	4532.85	...	....	....	....	....	....	33.05	+ 2	4533.1
D	Max	54.9528	4535.36	+25	4535.61	2	nn D	46.4529	4536.42	−67	4535.75	35.68	+ 2	4535.70
	to	54.9150	4536.20	+25	4536.45	...	...	....	....	....	....	36.65	+ 2	4536.7
1	B	54.8867	4536.88	+25	4537.13	3	n B	46.3675	4538.14	−67	4537.47	37.30	+ 2	4537.32
1	B	54.8070	4538.72	+25	4538.97	4	n B	46.2957	4540.00	−66	4539.34	39.16	+ 2	4539.18
...	nn D	54.7461	4540.13	+26	4540.39	3	n D	46.2280	4541.55	−66	4540.89	40.64	+ 2	4540.66
1	B	51.5893	4543.76	+27	4544.03	...	....	....	....	....	....	44.23	+ 2	4544.25

78 SCHJELLERUP — Continued

Plate G 344						Plate G 392						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.	t.m.	t.m.			mm.	t.m.	t.m.	t.m.	t.m.	t.m.	t.m.
3	n B	54.4395	4547.24	+27	4547.51	2	n B	45.9217	4518.60	−66	4517.94	47.73	+ 2	4547.75
...	nn D	54.3776	4548.69	+27	4548.96	3	wn D	45 8536	4550.16	−66	4549.50	49.23	+ 2	4549.25
7	wn D	54 2122	4553.57	+28	4553.85	...	wn D	45.6729	4554.36	−66	4553 70	53.77	+ 2	4553.79
...	....	....	....	....	....	B	from	45.5990	4556.10	−66	4555.44	55.24	+ 2	4555.3
1	n B	53 9760	4558.14	+29	4558.43		....	....	....	....	....	58.63	+ 2	4558.65
...	....	....	....	....	....		to	45.4110	4560.50	−65	4559.85	59.65	+ 2	4559.7
...	nn D	53.9010	4559.91	+29	4560.20	4	n D	45.3734	4561.35	−65	4560.70	60.45	+ 2	4560.47
...	....	....	....	....	....	3-4	n B	45.3065	4562 93	−65	4562.28	62.08	+ 2	4562.10
1-2	n D	53.7717	4562.99	+30	4563.29	4	n D	45.2464	4564.34	−65	4563.69	63.49	+ 2	4563.51
...	...	....	....	....	....	2	n B	45.1954	4565.54	−65	4564.89	64.69	+ 2	4564.71
1	nn D	53.6837	4565.06	+30	4565.36	1	nn D	45.1568	4566.46	−65	4565.81	65.59	+ 2	4565.61
B	from	53.6590	4565.60	+30	4565.90	B	from	45.1310	4567.10	−65	4566.45	66.25	+ 2	4566.3
	to	53.4860	4569.80	+32	4570.12		to	44.9620	4571 10	−64	4570.46	70.26	+ 2	4570.3
...	...	....	....	....	....	D	from	44.9620	4571.10	−64	4570 46	70.26	+ 2	4570.3
...	n D	53.3957	4572 00	+33	4572.33		....	....	....	....	....	72.53	+ 2	4572.55
D	from	53.3110	4574.00	+34	4574.34		....	....	....	....	....	74.54	+ 2	4574.6
	....	....	....	....	....	1	n D	44.6688	4578 08	−64	4577.44	77.24	+ 2	4577.26
	to	53.1650	4577.50	+35	4577.85		to	44.6390	4578.80	−64	4578.16	78.01	+ 2	4578.0
...	....	....	....	....	....	2	nn B	44.5807	4580.19	−64	4579.55	79.35	+ 2	4579.37
1	nn D	53.0742	4579.78	+35	4580.13	1-2	n D	44.5286	4581.45	−64	4580.81	80.45	+ 2	4580.47
...	....	....	....	....	....	1	n B	44.4855	4582 49	−63	4581.86	81.66	+ 2	4581.68
1	nn D	52.9933	4581.75	+36	4582.11	1-2	nn D	44 4433	4583.50	−63	4582.87	82.49	+ 2	4582.51
1	n B	52 9259	4583.40	+36	4583.76	4	n B	44.3945	4584.69	−63	4584.06	83.91	+ 2	4583.93
1	B	52.8595	4585.03	+37	4585.40	...	....	....	....	....	....	85.60	+ 2	4585.62
...	....	....	....	....	....	1	n D	44 2755	4587.57	−63	4586 91	86.74	+ 2	4586.76
...	....	....	....	....	....	Max	B	44 1490	4590.65	−62	4590.03	89.83	+ 2	4589.85
1	n D	52.6253	4590.79	+38	4591.17	...	....	....	....	....	....	91.37	+ 2	4591.39
2	wn B	52.4377	4595.44	+40	4595.84	6	n B	43.8969	4596.82	−62	4596 20	96.02	+ 2	4596.04
1	nn D	52.3860	4596.70	+40	4597.10	...	....	....	....	....	....	97 30	+ 2	4597.32
...	....	....	....	....	....	1	n B	43.7630	4600.12	−61	4599.51	99.31	+ 2	4599.33
2	n D	52.2386	4600.40	+42	4600.82	2	n D	43 6968	4601.75	−61	4601.14	00.98	+ 2	4601.00
...	....	....	....	....	....	1	n D	43.6087	4603.93	−61	4603.32	03.12	+ 2	4603.14
2	n D	51.9938	4606.54	+44	4606.98	4-5	n D	43.4458	4607.98	−60	4607.38	07.18	+ 2	4607.20
D	from	52.1630	4602 30	+42	4602.72	...	....	....	....	....	....	02.92	+ 2	4602.9
	to	51.9540	4607.60	+44	4608.04	...	....	....	....	....	....	08.24	+ 2	4608.3
	Head	51.9430	4607.80	+44	4608.24		Head	43.4110	4608.80	−60	4608.20	08.22	+ 2	4608.2
2	n B	51.9159	4608.51	+44	4608.95	...	....	....	....	....	....	09.15	+ 2	4609.17
1	n D	51.8746	4609.55	+45	4610.00	...	....	....	....	....	....	10.20	+ 2	4610.22
1	n B	51.7922	4611.64	+45	4612.09	...	....	....	....	....	....	12.29	+ 2	4612.31
2	n D	51.7267	4613.30	+46	4613.76	2	n D	43.1758	4614.74	−59	4614.15	13.96	+ 2	4613.98
6	B	51.6784	4614.53	+47	4615.00	6	B	43.1268	4615.97	−59	4615.38	15.19	+ 2	4615.21
2	n D	51.6215	4615.98	+47	4616.45	3-4	D	43.0775	4617.21	−58	4616.63	16.54	+ 2	4616.56
7	B	51.5707	4617.28	+48	4617.76	6	B	43.0082	4618.96	−58	4618.38	18.07	+ 2	4618.09
6	D	51.5014	4619.05	+48	4619.53	6	D	42.9394	4620.70	−58	4620.12	19.83	+ 2	4619.85
4-5	B	51.4338	4620.78	+48	4621.26	5	n B	42.8766	4622.29	−57	4621.72	21.49	+ 2	4621.51
3	D	51.3778	4622.22	+49	4622.71	2	n D	42.8177	4623.79	−57	4623.22	22.97	+ 2	4622.99
2	n B	51.3138	4623 87	+50	4624.37	...	....	....	....	....	....	21.57	+ 2	4624.59
...	n B	51.1820	4627.20	+51	4627.71	...	....	....	....	....	....	27.91	+ 2	4627.9
...	n D	51.1090	4629.10	+51	4629.61	...	wn D	42.5514	4630.59	−56	4630 03	29.82	+ 2	4629.84
5	B	50.7546	4638.40	+54	4638.94	4	B	42.1917	4639.86	−54	4639 32	39.13	+ 2	4639.15
5	D	50.6999	4639.84	+55	4640.39	5	D	42.1359	4641.31	−54	4640.77	40.58	+ 2	4640 60
3	n B	50.6430	4641.33	+55	4641 88	3	B	42.0783	4642.81	−53	4642.28	42.08	+ 2	4642.10
1	n B	50 5783	4643.04	+56	4643.60	...	....	....	....	....	....	43 80	+ 2	4643.82
...	....	....	....	....	....	...	n D	41.9076	4647.26	−53	4646 73	46.53	+ 2	4646.55
...	nn D	50.4000	4655.76	+59	4656.35	1	n D	41.5463	4656.78	−51	4656 27	56.31	+ 2	4656.33
...	n B	49.7716	4664.60	+62	4665.22	...	....	....	....	....	....	65 42	+ 2	4665.44
1	n D	49.6567	4667.73	+62	4668.35	...	n D	41 0770	4669 30	−49	4668.81	68.58	+ 2	4668.60
1	n D	48.0038	4713.96	+72	4714.68	...	n D	39.4022	4715.60	−38	4715 22	14 95	− 2	4714.97
Con. Spec.	from	47.9570	4715.30	+73	4716.03	...	....	....	....	....	....	16 23	+ 2	4716.3
	to	47.7840	4720.30	+74	4721.04	...	....	....	....	....	....	21.24	+ 2	4721.3
Max	B	47.9320	4716.00	+73	4716.73	...	....	....	....	....	....	16 93	+ 2	4717.0
...	n D	47.7092	4722.48	+74	4723.22	...	n D	39 1457	4722.92	−37	4722 55	22.67	+ 2	4722.69
D	from	47.3510	4732.90	+76	4733.66		limits	38.7120	4735.40	−35	4735 05	31. ±	+ 2	4731. ±
	to	47 2110	4737.20	+77	4737.97		limits	38.6130	4738.30	−34	4737.96	37.97	+ 2	4738 0
Max	D	47.2645	4735.49	+77	4736.26	10	w D	38.6618	4736.91	−35	4736 56	36.41	+ 2	4736.43

78 *SCHJELLERUP — Continued*

Plate G 344						Plate G 392						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
Con.	from	47.2070	4737.20	+77	4737.97	Con.	from	38 6130	4738.30	−31	4737.96	37.97	+ 2	4738.0
Spec.	to	47.0650	4741.30	+77	4742.07	Spec.	to	38.4630	4742.70	−33	4742.37	42.22	+ 2	4742.2
2-3	n B	47.1801	4737.99	+77	4738.76	7	B	38.5750	4739 44	−34	4739.10	38 93	+ 2	4738.95
10	wn D	47.0048	4743.20	+77	4743.97	10	D	38.4079	4744.34	−33	4714.01	43.99	+ 2	4744.01
...	....	....	....	....	....	Limits		38.4630	4742.70	−33	4742.37	42.17	+ 2	4742.2
...	....	....	....	....	....	Limits		38.3535	4745.94	−33	4745.61	45.41	+ 2	4745.4
	Head	46.9490	4744.80	+78	4745.58		Head	38.3535	4745.94	−33	4745.61	45.41	+ 2	4745.43
B	from	46.9490	4744.80	+78	4745.58	...	....	....	....	....	....	45.78	+ 2	4745.8
B	B	46.9200	4745.72	+78	4746.50	...	....	....	....	....	....	46.70	+ 2	4746.72
Max	....	....	....	....	....	1	n D	38.2025	4750.40	−32	4750.08	49.88	+ 2	4749.90
	to	46.5340	4757.30	+80	4758.10	...	....	....	....	....	....	58.30	+ 2	4758.3
2–3	n D	46.5063	4758.16	+80	4758.96	...	wn D	37.9029	4759.31	−31	4759.00	58.98	+ 2	4759.00
...	nn D	46.2660	4765.40	+81	4766.21	1	n D	37.6422	4767.15	−30	4766.85	66.53	+ 2	4766.55
1–2	nn D	46.0522	4772.04	+81	4772.85	1-2	n D	37.4554	4772.80	−29	4772.51	72.68	+ 2	4772.70
Max	B	45.9850	4774.10	+81	4774.91	2	n B	37.3635	4775.60	−29	4775.31	75.11	+ 2	4775.13
Limits	....	46.0190	4773.00	+81	4773.81	...	....	....	....	....	....	74.01	+ 2	4774.0
Limits	....	45.8670	4777.70	+82	4778.52	...	....	....	....	....	....	78.72	+ 2	4778.7
...	wn D	45.6792	4783.60	+82	4784.42	2	n D	37.0603	4784.89	−28	4784.61	84.52	+ 2	4784.54
1	n D	45.5138	4788.78	+82	4789.60	1	n D	36.8884	4790.19	−27	4789.92	89.76	+ 2	4789.78
Max	B	45.3270	4794.65	+82	4795.47	Max	B	36.7042	4795.92	−27	4795.65	95.56	+ 2	4795.58
...	....	....	....	....	....	Max	B	36.4873	4802.71	−26	4802.45	02.25	+ 2	4802.27
1	n D	44.9803	4805.68	+82	4806.50	2	nn D	36.3357	4807.48	−25	4807.23	06.87	+ 2	4806.89
...	....	....	....	....	....	1	n B	36.2005	4811.77	−25	4811.52	11.32	+ 2	4811.34
1	nn D	44.8111	4811.11	+82	4811.93	...	nn D	36.1672	4812.83	−25	4812.58	12.26	+ 2	4812.28
2–3	n D	44.6939	4814.89	+82	4815.71	3	wn D	36.0481	4816 62	−25	4816.37	16.04	+ 2	4816.06
B	from	44.6730	4815.50	+82	4816.32	B	from	36.0130	4817.70	−25	4817.45	16.89	+ 2	4816.9
	to	44.4730	4822.00	+81	4822 81		to	35.9170	4820.80	−25	4820.55	21.68	+ 2	4821.7
Max	B	44.6003	4817.92	+82	4818.74	Max	B	35.9400	4820.08	−25	4819.83	19.29	+ 2	4819.31
2	nn D	44.4450	4822.98	+81	4823.79	...	nn D	35.8040	4824.45	−25	4824.20	24.00	+ 2	4824.02
...	....	....	....	....	....	4	n B	35.7335	4826.72	−25	4826.47	26.27	+ 2	4826.29
1–2	n D	44.3181	4827.13	+81	4827.94	3	nn D	35.6665	4828.89	−25	4828.64	28.29	+ 2	4828.31
3	wn B	44.2406	4829.67	+81	4830.48	4	B	35 5994	4831.06	−25	4830.81	30.64	+ 2	4830.66
3	D	44.1856	4831.48	+81	4832.29	6	D	35.5345	4833.12	−25	4832.87	32.59	+ 2	4832.61
...	....	....	....	....	....	1	nn B	35.1417	4846.02	−25	4845.77	45.57	+ 2	4845.59
...	....	....	....	....	....	2	n B	34.9891	4851.07	−25	4850.82	50.62	+ 2	4850.64
1	nn D	43.5980	4851.04	+78	4851.82	1	n D	34.9514	4852.32	−25	4852.07	51.95	+ 2	4851.97
1–2	nn D	43.4935	4854.57	+78	4855.35	1	n D	34.8315	4856.31	−25	4856.06	55.71	+ 2	4855.73
...	....	....	....	....	....	2	n B	34.7751	4858.19	−25	4857.94	57.74	+ 2	4857.76
...	....	....	....	....	....	1	nn D	34.7088	4860.42	−25	4860.17	59.97	+ 2	4859.99
...	....	....	....	....	....	2	nn B	34.6651	4861.88	−25	4861.63	61.43	+ 2	4861.45
1	nn D	43.1985	4864.59	+76	4865.35	...	nn D	34.5475	4865.83	−26	4865.57	65.46	+ 2	4865.48
1–2	B	43.0744	4868.84	+76	4869.60	...	....	....	....	....	....	69.80	+ 2	4869.82
2	n D	43.0238	4870.58	+75	4871.33	3 4	n D	34.3641	4872.03	−26	4871.77	71.55	+ 2	4871.57
1–2	n D	42.9047	4874.68	+74	4875.42	1 2	n D	34.2493	4875.93	−27	4875.66	75.54	+ 2	4875.56
1–2	n B	42.7844	4878.85	+74	4879.59	...	....	....	....	....	....	79.79	+ 2	4879.81
3	n D	42.7254	4880.89	+73	4881.62	3	D	34.0713	4882.02	−27	4881.75	81.69	+ 2	4881.71
1	n B	42.6705	4882.81	+73	4883.54	...	....	....	....	....	....	83.74	+ 2	4883.76
...	nn D	42.5963	4885.39	+73	4886.12	...	....	....	....	....	....	86.32	+ 2	4886.34
...	nn D	42.4570	4890.20	+72	4890.92	...	....	....	....	....	....	91.12	+ 2	4891.14
...	....	....	....	....	....	3	nn B	33.5729	4899.27	−29	4898.98	98.78	+ 2	4898.80
1	nn D	42.1798	4900.06	+69	4900.75	...	nn D	33.4900	4902.17	−29	4901.88	01.32	+ 2	4901.34
2–3	nn D	41.6290	4919.82	+66	4920.48	...	nn D	32.9357	4921.79	−32	4921.47	20.98	+ 2	4921.00
1	n D	41.4997	4924.52	+65	4925.17	...	....	....	....	....	....	25.37	+ 2	4925.39
...	nn D	41.2530	4933.50	+63	4934.13	1	n D	32.5875	4934.33	−31	4933.99	33.79	+ 2	4933.81
...	nn D	40.6280	4956.80	+58	4957.38	...	....	....	....	....	....	57.58	+ 2	4957.60

78 *SCHJELLERUP*

PLATE G 300 1899, March 6, G.M.T. 14h8. Hour angle, W 2h0 Star good; comparison good						PLATE G 384 1900, February 9, G.M.T. 18h4. Hour angle, W 2h9 Star good; comparison good						MEAN WAVE-LENGTH		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	...	nn D	47.8443	5161.72	−42	5164.30	61.24	+2	5164.26
6	wn D	48.4927	5173.43	−47	5172.96	2	n D	47.6098	5171.04	−44	5173.60	73.28	+2	5173.30
1	n D	48.2176	5184.30	−52	5183.78	...	n D	47.3500	5184.50	−45	5184.05	83.92	+2	5183.94
1	n D	48.0836	5189.63	−51	5189.09	...	....	....	....	....	....	89.15	+2	5189.17
3	n D	47.9884	5193.44	−56	5192.88	...	wn D	47.1157	5193.96	−47	5193.49	93.19	+2	5193.21
2	n D	47.6671	5206.38	−62	5205.76	...	....	....	....	....	....	05.82	+2	5105.84
...	....	....	....	....	....	...	wn D	46.7480	5209.00	−48	5208.52	08.46	+2	5208.48
2	nn B	47.4602	5214.80	−66	5214.14	...	....	....	....	....	....	14.20	+2	5214.22
1 2	n D	47.4002	5217.26	−67	5216.59	1	n D	46.5500	5217.20	−48	5216.72	16.66	+2	5216.68
9	wn D	47.1690	5226.76	−70	5226.06	...	wn D	46.3139	5227.08	−49	5226.59	26.33	+2	5226.35
6	n D	46.9888	5234.23	−74	5233.49	1	nn D	46.1290	5234.90	−49	5234.41	33.95	+2	5233.97
6	n D	46.6577	5248.07	−79	5247.28	4	n D	45.8192	5248.03	−49	5247.54	47.41	+2	5247.43
4	wn D	46.5657	5251.95	−80	5251.15	2	nn D	45.7209	5252.24	−49	5251.75	51.45	+2	5251.47
1	nn D	46.4702	5255.99	−82	5255.17	...	....	....	....	....	....	55.23	+2	5255.25
3	n D	46.1146	5271.17	−86	5270.31	3	n D	48.2825	5271.23	−48	5270.75	70.53	+2	5270.55
2	nn B	45.8969	5280.56	−89	5279.67	...	....	....	....	....	....	79.73	+2	5279.75
1	nn D	45.8049	5284.56	−89	5283.67	...	nn D	45.0008	5283.60	−47	5283.13	83.41	+2	5283.43
1	n D	45.4899	5298.34	−92	5297.42	...	wn D	44.6710	5298.26	−47	5297.79	97.61	+2	5297.63
2	n D	45.3846	5302.98	−92	5302.06	...	....	....	....	....	....	02.12	+2	5302.14
3	nn B	45.3227	5305.72	−93	5304.79	1–2	n B	44.5083	5305.56	−46	5305.10	04.95	+2	5304.97
1	nn D	45.2647	5308.29	−93	5307.36	...	....	....	....	....	....	07.42	+2	5307.44
3	n B	45.1380	5313.93	−93	5313.00	2	n B	44.3315	5313.55	−46	5313.09	13.05	+2	5313.07
3	n D	45.0951	5315.85	−93	5314.92	2	n D	44.2817	5315.68	−46	5315.22	15.07	+2	5315.09
6	n B	45.0411	5318.26	−93	5317.33	2–3	n B	44.2285	5318.24	−45	5317.79	17.56	+2	5317.58
...	nn D	44 9791	5321.04	−93	5320.11	...	....	....	....	....	....	20.17	+2	5320.19
5	n D	44.7933	5329.42	−92	5328.50	1–2	nn D	43.9740	5329.89	−41	5329.45	28 98	+2	5329.00
5	wn B	44.6603	5335.45	−91	5334.54	2 3	n B	43.8491	5335.65	−44	5335.21	31.88	+2	5334.90
2	n D	44.6137	5337.57	−91	5336.66	1	nn D	43.8101	5337.45	−41	5337.01	36.84	+2	5336.86
5	wn B	44 5633	5339.86	−90	5338.96	2–3	n B	43.7622	5339.67	−43	5339.21	39.10	+2	5339.12
2	D	44.5122	5342.20	−90	5341.30	1–2	nn D	43.7065	5342.26	−43	5341.83	41.57	+2	5341.59
...	....	....	....	....	....	1	nn B	43.6452	5345.11	−43	5344.68	44.62	+2	5344.64
2 3	n D	44.3313	5350.50	−86	5349.64	...	wn D	43.5437	5349.88	−42	5349.46	49.55	+2	5349.57
...	....	....	....	....	....	1	n B	43.4833	5352.69	−42	5352.27	52.21	+2	5352.23
...	nn D	43.9718	5367.18	−79	5366.39	...	nn D	43.1809	5366.98	−40	5366.58	66.49	+2	5366.51
3	n B	43.9193	5369.63	−78	5368.85	...	....	....	....	....	....	68.91	+2	5368.93
6	D	43.8618	5372.33	−76	5371.57	5 6	n D	43.0726	5372.14	−39	5371.75	71.66	+2	5371.68
7	B	43.7877	5375.82	−74	5375.08	2	n B	43.0051	5375.36	−39	5374.97	75.03	+2	5375.05
2	n D	43.7409	5378 02	−73	5377.30	2	n D	42.9539	5377.82	−39	5377.43	77.36	+2	5377.38
9	wn B	43.6727	5381.24	−70	5380.54	2	wn B	42.8934	5380.73	−38	5380.35	80.45	+2	5380.47
...	wn D	43.5840	5385.44	−65	5384.79	...	....	....	....	....	....	84.85	+2	5384.87
...	....	....	....	....	....	1	nn D	42.6847	5390.81	−37	5390.44	90.38	+2	5390.40
9	wn D	43.3332	5397.40	−59	5396.81	6 8	wn D	42.5508	5397.32	−36	5396.96	96.89	+2	5396.91
2	nn D	43.0561	5410.76	−52	5410.24	...	nn D	42.2907	5410.08	−35	5409.73	09.99	+2	5410.01
1	n D	42.9725	5414.82	−50	5414 32	...	....	....	....	....	....	14.38	+2	5414.40
7 8	n B	42.9139	5417.67	−48	5417.19	2–3	n B	42.1373	5417.66	−31	5417.32	17.26	+2	5417.28
3	n D	42.8416	5421.20	−46	5420.74	3	n D	42.0780	5420.61	−31	5420.27	20.51	+2	5420.53
2	n B	42.7938	5423.50	−45	5423.05	...	....	....	....	....	....	23.11	+2	5423.13
3	n D	42.6488	5430 67	−42	5430.25	2–3	n D	41.8787	5430.57	−33	5430.24	30.25	+2	5430.27
2	n D	42.5633	5434.89	−40	5434.49	...	....	....	....	....	....	34 55	+2	5434.57
	from	42.4610	5440.00	−38	5439.62	...	....	....	....	....	....	39.68	+2	5439.7
B	....	....	....	....	....	Max	B	41.6340	5442.90	−32	5442.58	42.52	+2	5442.54
	to	42.3340	5446.30	−36	5445.94	...	....	....	....	....	....	46.00	+2	5446.0
9	n D	42.2911	5448 25	−35	5447.90	8	n D	41.5415	5447.62	−32	5447.30	47.60	+2	5447.62
...	....	....	....	....	....		from	41.5070	5449.36	−32	5449.04	48.98	+2	5449.0
Max	B	42.2328	5451.31	−34	5451.00	B	....	....	....	....	....	51 06	+2	5451.08
...	....	....	....	....	....		to	41.3880	5455.44	−31	5455.13	55.07	+2	5455.1
1–2	n D	42.1175	5457.11	−32	5456.82	...	nn D	41.3565	5457.07	−31	5456.76	56.79	+2	5456.81
1 2	n D	42.0339	5461.36	−31	5461.05	1	nn D	41.2772	5461.14	−31	5460.83	60.91	+2	5460.96
2	n D	41.8930	5468.50	−30	5468.20	...	wn D	41.1319	5468.65	−30	5468.35	68.28	+2	5468.30
2	n B	41.8081	5472.84	−29	5472.55	...	....	....	....	....	....	72 61	+2	5472.63
...	....	....	....	....	....	1	nn D	41.0135	5474.80	−30	5474.50	74.44	+2	5474.46
...	....	....	....	....	....	1	nn D	40.9408	5478.59	−30	5478.29	78.23	+2	5478.25
1	n D	41.5984	5483.57	−27	5483.30	1	nn D	40.8503	5483.33	−30	5483.03	83 17	+2	5483.19
...	....	....	....	....	....		from	40.5890	5497.10	−29	5496.81	96 75	+2	5496.8
3–4	n D	41.3067	5498.69	−25	5498.11	D	....	....	....	....	....	98.20	+2	5498.22
...	....	....	....	....	....		to	40.4560	5501.20	−29	5503.91	03.85	+2	5503.9

78 *SCHJELLERUP—Continued*

Plate G 300						Plate G 384						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
3	n B	41.0955	5509.74	−23	5509.51	...	....	....	....	....	....	09.57	+2	5509.59
3	n D	41.0422	5512.55	−23	5512.32	...	nn D	40.2948	5512.81	−29	5512.52	12.42	+2	5512.44
1–2	nn D	40.7966	5525.56	−22	5525.34	...	wn D	40.0551	5525.80	−28	5525.52	25.43	+2	5525.45
1	nn D	40.6240	5534.76	−22	5534.54	...	....	....	....	....	....	34.60	+2	5534.62
...	....	....	....	....	....	1	B	39.8639	5536.17	−28	5535.89	35.83	+2	5535.85
8	w D	40.5270	5540.00	−22	5539.78	6–8	D	39.8020	5539.56	−28	5539.28	39.53	+2	5539.55
B	from	40.4820	5542.40	−22	5542.18	B	from	39.7530	5542.30	−28	5542.02	42.10	+2	5542.1
	to	40.3890	5547.50	−22	5547.28		to	39.6560	5547.60	−28	5547.32	47.30	+2	5547.3
2	n D	40.3678	5548.61	−22	5548.39	1	n D	39.6299	5549.05	−28	5548.77	48.58	+2	5548.60
1	n D	40.2939	5552.62	−22	5552.40	0–1	nn D	39.5635	5552.73	−28	5552.45	52.43	+2	5552.45
1	n D	40.2238	5556.44	−22	5556.22	0–1	nn D	39.4905	5556.78	−28	5556.50	56.36	+2	5556.38
...	n D	40.1000	5563.20	−22	5562.98	0–1	nn D	39.3853	5562.65	−28	5562.37	62.68	+2	5562.70
1–2	n D	40.0241	5567.39	−22	5567.17	1	n D	39.2985	5567.52	−28	5567.24	67.21	+2	5567.23
1	n D	39.9680	5570.50	−22	5570.28	...	....	....	....	....	....	70.34	+2	5570.36
...	....	....	....	....	....		from	39.1860	5573.90	−28	5573.62	73.56	+2	5573.6
1	n D	39.8936	5574.59	−22	5574.37	D	....	....	....	....	....	74.43	+2	5574.45
Max	D	39.7204	5584.21	−22	5583.99	6	D	39.0016	5584.29	−28	5584.01	84.00	+2	5584.02
...	....	....	....	....	....		to	38.9680	5586.20	−28	5585.92	85.84	+2	5585.9
Head		39.6840	5586.22	−22	5586.00	Head		38.9670	5586.30	−28	5586.02	86.01	+2	5586.03
3	B	39.6628	5587.43	−22	5587.21	3	B	38.9156	5587.48	−28	5587.20	87.21	+2	5587.23
1	nn D	39.6240	5589.61	−22	5589.39	1	n D	38.9122	5589.38	−28	5589.10	89.25	+2	5589.27
2–3	n B	39.5700	5592.63	−23	5592.40	3	n B	38.8661	5592.03	−28	5591.75	92.08	+2	5592.10
2	n D	39.5227	5595.29	−23	5595.06	2	n D	38.8111	5595.18	−28	5594.90	94.96	+2	5594.98
4	B	39.4770	5597.87	−23	5597.64	3	B	38.7651	5597.82	−28	5597.54	97.59	+2	5597.61
1	nn D	39.4206	5601.05	−24	5600.81	1–2	nn D	38.7239	5600.19	−28	5599.91	00.36	+2	5600.38
	from	39.3020	5607.80	−24	5607.56	...	....	....	....	....	....	07.62	+2	5607.6
D	....	....	....	....	....	...	nn D	38.5591	5609.72	−28	5609.44	09.50	+2	5609.52
	to	39.2230	5612.30	−24	5612.06	...	....	....	....	....	....	12.12	+2	5612.1
	from	39.1080	5618.80	−25	5618.55	...	....	....	....	....	....	18.61	+2	5618.6
Max	D	39.0838	5620.23	−25	5619.98	2	n D	38.3739	5620.51	−28	5620.33	20.16	+2	5620.18
Max	D	38.9900	5625.60	−25	5625.35	...	nn D	38.2854	5625.70	−28	5625.42	25.36	+2	5625.38
	to	38.9600	5627.30	−26	5627.04	...	....	....	....	....	....	27.10	+2	5627.1
8	D	38.8405	5634.26	−26	5634.00	10	D	38.1328	5634.70	−28	5634.42	34.21	+2	5634.23
Head		38.7964	5636.81	−26	5636.55	Head	....	38.0896	5637.26	−28	5636.98	36.77	+2	5636.79
	from	38.7964	5636.81	−26	5636.55	...	....	....	....	....	....	36.77	+2	5636.8
B 8	n B	38.7658	5638.60	−27	5638.33	...	B	38.0571	5639.19	−28	5638.91	38.62	+2	5638.64
6	n B	38.7102	5641.84	−27	5641.57	...	B	38.0102	5641.97	−29	5641.68	41.63	+2	5641.65
	to	38.6950	5642.70	−27	5642.43	...	....	....	....	....	....	42.49	+2	5642.5
2	nn D	38.6625	5644.62	−28	5644.34	1	n D	37.9680	5644.49	−29	5644.20	44.27	+2	5644.29
1	nn D	38.5603	5650.61	−28	5650.33	1	nn D	37.8694	5650.39	−29	5650.10	50.22	+2	5650.24
...	nn B	38.5130	5653.40	−28	5653.12	...	....	....	....	....	....	53.18	+2	5653.2
...	....	....	....	....	....	2	n B	37.7830	5655.57	−29	5655.28	55.22	+2	5655.24
...	nn D	38.4306	5658.25	−29	5657.96	1	n D	37.7503	5657.54	−29	5657.25	57.61	+2	5657.63
3	nn D	38.2098	5671.35	−31	5671.04	2	n D	37.5132	5671.89	−30	5671.59	71.32	+2	5671.34
2	nn B	38.1633	5674.13	−32	5673.81	1–2	n B	37.4736	5674.31	−30	5674.01	73.91	+2	5673.93
1–2	nn D	38.1202	5676.70	−32	5676.38	2	n D	37.4327	5676.81	−30	5676.51	76.45	+2	5676.47
2	n B	38.0704	5679.69	−32	5679.37	...	....	....	....	....	....	79.43	+2	5679.45
1–2	n B	37.9977	5684.06	−33	5683.73	...	....	....	....	....	....	83.79	+2	5683.81
8	wn B	37.8353	5693.88	−34	5693.54	6	n B	37.1484	5694.30	−31	5693.99	93.77	+2	5693.79
1	nn D	37.7910	5696.60	−35	5696.25	...	....	....	....	....	....	96.31	+2	5696.33
4	n B	37.6508	5705.12	−36	5704.76	5	n B	36.9668	5705.60	−31	5705.29	05.03	+2	5705.05
3–4	n D	37.6018	5708.12	−37	5707.75	2	n D	36.9191	5708.58	−31	5708.27	08.01	+2	5708.03
1	nn D	37.5210	5713.10	−37	5712.73	1	n D	36.8338	5713.93	−32	5713.61	13.17	+2	5713.19
6	wn B	37.4514	5717.37	−38	5716.99	8	wn B	36.7731	5717.74	−32	5717.42	17.21	+2	5717.23
1	n D	37.3829	5721.61	−39	5721.22	2	n D	36.7063	5721.97	−32	5721.65	21.44	+2	5721.46
6	wn B	37.3330	5724.70	−39	5724.31	6	wn B	36.6566	5725.12	−32	5724.80	24.56	+2	5724.58
3–4	n D	37.2257	5731.38	−40	5730.98	8	wn D	36.5441	5732.27	−33	5731.94	31.46	+2	5731.48
...	....	....	....	....	....		from	36.3830	5742.60	−33	5742.27	42.21	+2	5742.2
3	n D	37.0343	5743.37	−43	5742.94	D	....	....	....	....	....	43.00	+2	5743.02
2	nn D	36.9297	5750.00	−44	5749.56	1	n D	36.2611	5750.44	−34	5750.10	49.83	+2	5749.85
...	....	....	....	....	....		to	36.2490	5751.20	−34	5750.86	50.80	+2	5750.8
3	nn D	36.7301	5762.66	−46	5762.20	1	n D	36.0743	5762.56	−35	5762.21	62.21	+2	5762.23
3	nn D	36.6045	5770.70	−48	5770.22	3	n D	36.9375	5771.51	−35	5771.16	70.69	+2	5770.71

78 *SCHJELLERUP*—*Continued*

Plate G 300						Plate G 384						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
B	from	36.5790	5772.30	−50	5771.80	...	....	....	....	....	....	71.86	+2	5771.9
	to	36.4460	5780.90	−50	5780.40	...	....	....	....	....	....	80.46	+2	5780.5
D	......	....	....	....	....	3	wn D	35.7232	5785.63	−36	5785.27	85.21	+2	5785.23
	to	36.3620	5786.30	−50	5785.80	...	....	....	....	....	....	85.86	+2	5785.9
1	nn D	36.3005	5790.36	−51	5789.85	...	....	....	....	....	....	89.91	+2	5789.93
2	n D	36.1827	5798.05	−52	5797.53	...	....	....	....	....	....	97.59	+2	5797.61
1	nn D	36.0953	5803.79	−53	5803.26	1 2	n D	35.4446	5801.24	−38	5803.86	03.56	+2	5803.58
1	nn D	35.8080	5822.80	−60	5822.20	1	nn D	35.1549	5823.87	−39	5823.48	22.84	+2	5822.86
1	n D	35.3991	5850.34	−60	5849.74	...	....	....	....	....	....	49.80	+2	5849.82

132 *SCHJELLERUP* = *U HYDRAE*

Plate A 328 1902, February 21, G.M.T. 18h3 Hour angle, E 0h7 Star excellent; comparison fair						Plate G 309 1899, March 23, G.M.T. 17h8 Hour angle, W 1h4 Star fair; comparison fair						Plate G 368 1899, December 29, G.M.T. 22h4 Hour angle, W 0h2 Star fair; comparison fair						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
Spec.	begins	22.4500	4295 9	+3±	4296.2		......	....		....	.....	...	......	....	....	....	.....	96.2	+40	4296.6
....	......	....	....	....	....	Begi	ns	63.9510	76.84	−3	76.81	Begi	ns	57 6150	71 3	+39	71.7	74.	+41	4374.
....	......	....	....	....	....	..	......	....	.....	....	.....	1	nn D	57 4080	75.1	+38	75 5	75.5	+41	4375.9
....	......	....	....	....	....	..	......	....	.....	....	.....	1	nn D	57 1090	80 6	+36	81 0	81.0	+41	4381.4
....	......	....	....	....	....	1	n D	63.5061	84.90	−7	84.83	.	......	....	....	....	.....	84.83	+41	4385.2
2	n B	30.9127	4388.25	+11	4388.36	...	......	....	.....	....	.....	.	......	....	....	....	.....	88.36	+41	4388.77
....	wn D	30.9927	4389.19	+11	4389.30	1-2	n D	63.2453	89.60	−8	89.52	1	n D	56.6559	88.94	+33	89.27	89.36	+41	4389.77
2	n D	31.1845	4391.44	+10	4391.54	.	......	....	.....	....	.....	.	......	....	.....	....	.....	91.54	+41	4391.95
2	n B	31.2402	4392.33	+10	4392.43	..	......	....	.....	....	.....	.	......	....	.....	....	.....	92.43	+41	4392.84
..	wn D	31.4565	4394.65	+10	4394.75	...	w D	62.9775	94 50	−9	94 41	..	wn D	56 3620	94 50	+31	94 81	94.66	+41	4395.07
Con. Spec.	from	31.5080	4395.26	+9	4395.35	..	......	....	...	....	..	.	......	....	.....	....	...	95.35	+41	4395.76
	to	31.6885	4397.40	+9	4397.49	.	......	....	...	....		.	......	....	.....	....	...	97.49	+41	4397.90
1–2	n D	31.7174	4397.71	+9	4397.83	.	......	....	...	....	...	.	......	....	.....	....	...	97.83	+41	4398.24
....	wn D	31.9405	4400.39	+8	4400.47	1–2	n D	62.6435	00.70	−11	00 59	.	wn D	56.0649	00.08	+29	00.37	00.48	+41	4400.89
8	n B	32.0714	4401.96	+7	4402.03	2	B	62.5620	02 21	−12	02.09	.	......	....	.....	....	.....	02.06	+41	4402.47
4	D	32.1442	4402.83	+6	4402.89	...	......	....	.....	....	.....	.	......	....	.....	....	.....	02.89	+41	4403.30
....	nn D	32.2810	4404.46	+6	4404.52	1–2	n D	62.4060	05 12	+13	04 99	.	wn D	55 8380	04 70	+28	04.98	04.83	+41	4405.24
7	D	32.5915	4408.20	+5	4408.25	1	n D	62.2470	08 10	−14	07.96	.	wn D	55 6610	07 80	+28	08.08	08.10	+41	4408.51
1	n D	32.8023	4410.74	+5	4410.79	...	....	....	...	....	.....	.	......	....	.....	....	.....	10.79	+41	4411.20
5	D	32.8915	4411.82	+4	4411.86	..		....	...	....	.....	1	nn D	55 4675	11.52	+26	11.78	11.82	+41	4412.23
Con. Spec.	from	32.9290	4412.30	+4	4412.34	...		....	...	....	.....	...	......	....	.....	....	.....	12.34	+41	4412.8
	to	33.0905	4414.24	+3	4414.27	..	......	....	...	....	.....	...	......	....	.....	....	.....	14.27	+41	4414 7
3	D	33.1225	4414.63	+3	4414.66	1	n D	61.8679	15 25	−17	15 08	...	......	....	.....	....	.....	14.87	+41	4415.28
2	D	33.2569	4416.27	+3	4416.30	..	......	....	.....	...	.....	...	......	....	.....	....	.....	16.30	+41	4416.71
1	n D	33.3415	4417.30	+3	4417.33	...	......	....	.....	....	.....	...	......	....	.....	....	.....	17.33	+41	4417.74
Con. Spec.	from	33.3605	4417.53	+3	4417.56	...	......	....	.....	....	.....	...	......	....	.....	....	.....	17.56	+41	4418.0
	to	33.5515	4419.87	+2	4419.89	...	......	....	.....	....	.....	...	......	....	.....	....	.....	19.89	+41	4420.3
2	n D	33.5760	4420.17	+2	4420.19	...	......	....	.....	....	.....	...	......	....	.....	....	.....	20.19	+41	4420.60
2	n B	33.6228	4420.75	+2	4420.77	...	......	....	.....	....	.....	...	......	....	.....	....	.....	20.77	+41	4421.18
2 3	D	33.6657	4421.27	+2	4421.29	...	......	....	.....	....	.....	...	......	....	.....	....	.....	21.29	+41	4421.70
3	n B	33.8522	4423.57	+1	4423.58	...	......	....	.....	....	.....	...	......	....	.....	....	.....	23.58	+41	4423.99
5 6	D	34.0085	4425.49	+1	4425.50	...	......	....	.....	....	.....	1	nn D	54.7675	25.17	+22	25.39	25.45	+41	4425.86
6	B	34.0723	4426.28	0	4426.28	...	......	....	.....	....	.....	...	......	....	.....	....	.....	26.28	+41	4426.69
6	D	34.1314	4427 02	0	4427.02	1–2	n D	61.2244	27.57	−20	27.37	1	nn D	54.6658	27.32	+21	27.53	27.31	+41	4427.75
D	from	34.3100	4429 23	0	4429.23	...	......	....	.....	....	.....	...	......	....	.....	....	.....	29.23	+41	4429.6
	......	....	....	....	....	1–2	n D	61.0856	30 25	−21	30 04	2	n D	54.5489	29.49	+20	29 69	29.87	+41	4430.28
	to	34.4115	4430 49	−1	4430.48	...	......	....	.....	....	.....	...	......	....	.....	....	.....	30.48	+41	4430.9
Con.	from	34.4115	4430.49	−1	4430.48	...	......	....	.....	....	.....	...	......	....	.....	....	.....	30.48	+41	4430.9
	......	....	....	....	....	...	......	....	.....	....	.....	1	n D	54.3559	33 32	+19	33.51	33.51	+41	4433.92
Spec	to	34.7375	4434.56	−1	4434.55	...	......	....	.....	....	.....	...	......	....	.....	....	.....	34.55	+41	4435.0
	D	34 7762	4435.05	−1	4435 04	...	wn D	60.8135	35 55	−23	35.32	3	n D	54.2707	35 02	+19	35 21	35.19	+41	4435.60
Limits		34.7375	4434.56	−1	4434.55	...	......	....	.....	....	.....	...	......	....	...	....	.....	34.55	+41	4435.0
		34.8160	4435.92	−1	4435.91	...	......	....	.....	....	.....	...	......	....	...	....	.....	35.91	+41	4436.3
7	D	34.9934	4437.77	2	4437.75	0–1	D	60.6908	37.95	−24	37.71	...	......	....	...	....	.....	37.73	+41	4438.14
4	n B	35.0185	4438.47	−2	4438.45	...	......	....	.....	....	.....	...	......	....		....	.....	38.45	+41	4438.96
Con	Spec.	....	....	....	....	1–2	n D	60 4585	42.52	−25	42.27	...	......	....		....	.....	42 27	+41	4442.68
6	D	35 4944	4441.10	3	4441 07	1	n D	60 3642	41 38	−26	41 12	...	......	....	.....	....	.....	44 10	+41	4441.51
5	B	35 5475	4441.78	−3	4441 75	...	......	....				...	......	....	.....	....	.....	44.75	+41	4445.16
2	D	35 5897	4445.31	−4	4445.27	...	......	....	.....	....	.	...	......	....	.....	....	.....	45.27	+41	4445.68
3	n B	35.6267	4445.77	−4	4445.73	...	......	....	.....	....	.....	...	......	....	.....	....	.....	45.73	+41	4446.14
	......	....	....	.	....	2	nn D	60 2085	47.47	−26	47 21	1 2	n D	53.6950	46.70	+15	46 85	47 03	+41	4447.44
8	n B	35 8222	4448.28	−4	4448.24	...	......	....	.....	....	.....	...	......	....	.....	....	.....	48.21	+41	4448.65
...	...	....	....	.	....	2–3	n D	60.0866	49.89	−27	49.62	2	n D	53.5532	49.50	+11	49.64	49 63	+41	4450.04
1 2	n D	36 2067	4453.20	5	4453.15	1	nn D	59 9270	53 06	−28	52.78	1	n D	53.4048	52.53	+14	52.67	52 87	+42	4453 29
5	B	36 2580	4453.86	−5	4753.81	...	....	....	.....	....	.....	...	......	....	.....	....	.....	53.81	+42	4454.23

132 *SCHJELLERUP — Continued*

Plate A 328						Plate G 309						Plate G 368						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
3	D	36.3140	4454.58	− 5	4454.53	2	D	59.8036	55.56	−29	55.27	1	n D	53.2945	54.79	+13	54.92	54.91	+42	4455.33
0–1	D	36.4540	4456.40	− 6	4456.34													56.34	+42	4456.76
4	n B	36.6134	4458.45	− 6	4458.39													58.39	+42	4458.81
D	from	36.6530	4458.96	− 6	4458.90													58.90	+42	4459.3
	to	36.7460	4460.17	− 6	4460.11													60.11	+42	4460.5
8	w D	36.8570	4461.61	− 6	4461.55		w D	59.4780	62 10	−30	61.80							61.68	+42	4462.10
						B	from	59.4390	62.90	−31	62.59							62.59	+42	4463.0
8	B	37.0188	4463.71	− 6	4463.65		mid	59.3906	63.96	−31	63.59	2	n B	52.8815	63.62	+11	63.73	63.66	+42	4464 08
							to	59.3520	64.70	−31	64.39							64.39	+42	4464 8
1	n D	37.1487	4465.41	− 7	4465.34													65.34	+42	4465.76
2	D	37.2358	4466.55	− 7	4466.48													66.48	+42	4466 90
1	D	37.3822	4468.60	− 7	4468.53								n D	52.6320	68.60	+ 9	68.69	68.61	+42	4469.02
2	n D	37.6025	4471.37	− 7	4471.30													71.30	+42	4471.72
2	B	37.6492	4471.97	− 7	4471.90													71.90	+42	4472.32
3	D	37.6977	4472.62	− 7	4472.55													72.55	+42	4472.97
						B	from	58.9530	72.90	−33	72.57							72.57	+42	4473.0
4–5	B	37.7424	4473.21	− 8	4473.13													73.13	+42	4473.55
1	n B	37.8055	4474.05	− 8	4473.97		Max	58.8770	74 43	−33	74.10							74.04	+42	4474.46
							to	58.8530	74 90	−33	74.57							74.57	+42	4475.0
												1	nn D	52.3330	74.80	+ 9	74.89	74.89	+42	4475.31
1	D	37.9387	4475.81	− 8	4475.73	1	n D	58.8281	75.44	−34	75.10							75.42	+42	4475.84
4	n B?	38.1660	4478.83	− 9	4478.74							2–3	B	52.1582	78.50	+ 8	78.58	78.66	+42	4479.08
2–3	n D	38.2485	4479.53	− 9	4479.44	2–3	n D	58.5924	80.32	−35	79.97							79.71	+42	4480.13
5	D	38.4142	4482.15	− 9	4482.06	2–3	n D	58.4879	82.50	−35	82.15	1	n D	51.9957	81.96	+ 8	82.04	82.08	+42	4482.50
Con. Spec.	from	38.4550	4482.70	− 9	4482.61													82.61	+42	4483.0
	to					1	B	58.4417	83.46	−35	83.11	1	B	51.9518	82.89	+ 8	82.97	83.04	+42	4483.46
5	n B	38.6939	4485.90	− 9	4485.81							1	B	51.8269	85.56	+ 8	85.64	85.73	+42	4486.15
3	n D	38.7742	4486.98	− 9	4486.89	1–2	n D	58.2556	87.36	−36	87.00	1	n D	51.7712	86.76	+ 8	86.84	86.91	+42	4487.33
1	n B	38.8179	4487.57	− 9	4487.48													87.48	+42	4487.92
5	n B	38.8790	4488.39	−10	4488.29							1–2	B	51.7018	88.18	+ 7	88.25	88.27	+42	4488.69
3	D	38.9655	4489.56	−10	4489.46	3	n D	58.1421	89.75	−37	89.38	2	n D	51.6606	89.13	+ 7	89.20	89.35	+42	4489.77
Con. Spec.	from	39.0005	4490.04	−10	4489.94													89.94	+42	4490.4
	to	39.4300	4495.90	−10	4495.80													95.80	+42	4496.2
8	w D	39.4790	4496.54	−10	4496.44	6	n D	57.7964	97.07	−38	96.69	2–3	n D	51.3182	96.54	+ 7	96.61	96.57	+42	4496.99
Con. Spec.	from	39.5600	4497.64	−10	4497.54													97.54	+42	4498.0
	to	39.8015	4500.95	−10	4500.85													00.85	+42	4501.3
8	w D	39.8505	4501.62	−10	4501.52	1–2	n D	57.5780	01.70	−38	01.32		nn D	51.0890	01.60	+ 6	01.66	01.50	+42	4501.92
3	n B	39.9327	4502.75	−10	4502.65	B	from	57.536	02.60	−39	02.21	Max	B	51.0351	02.72	+ 6	02.78	02.72	+42	4503.14
3	n B	40.0289	4504 07	−10	4503.97													03.97	+42	4504.39
3–4	n B?	40.1240	4505.39	−10	4505.29													05.29	+42	4505.71
							to	57.3770	06.00	−39	05.61							05.61	+42	4506.0
2	n D	40.2382	4506.97	−10	4506.87	2	nn D	57.3290	07.10	−39	06.71		wn D	50.8649	06.46	+ 6	06.52	06.70	+42	4507.12
B	from	40.3105	4507.97	−10	4507.87													07.87	+42	4508.3
												Max	B	50.7875	08.17	+ 6	08.23	08.23	+42	4508.65
	to	40.3940	4509.13	−10	4509.03													09.03	+42	4509.5
3	n D	40.4252	4509.57	−10	4509.47	1	nn D	57.2020	09.80	−39	09.41							09.47	+42	4509.89
3	n B?	40.4815	4510.34	−10	4510.24													10.24	+42	4510.66
2	n D	40.6326	4512.45	−10	4512.35								wn D	50.5960	12.41	+ 6	12.47	12.41	+42	4512.83
	nn D	40.7550	4514.15	−10	4514.05													14.05	+42	4514.47
1	n D?	40.8884	4516.02	−10	4515.92													15.92	+42	4516.34
4	n B	40.9572	4516.99	−10	4516.89													16.89	+42	4517.31
3	D	41.0137	4517.77	−10	4517.67	1	n D	56.8076	18.43	−39	18.04	2	nn D	50.3450	18.01	+ 7	18.08	17.93	+42	4518.35
1	n D	41.1986	4520.38	−10	4520.28	1	n D	56.7000	20.70	−40	20.30							20.29	+42	4520.71
B	from	41.2135	4520.59	−10	4520.49													20.49	+42	4520.9
						2	n B	56.6586	21.70	−40	21.30	3–4	B	50.1989	21.28	+ 7	21.35	21.33	+42	4521.75
	to	41.3175	4522.06	−10	4521.96													21.96	+42	4522.4
6	D	41.3615	4522.67	−10	4522.57		w D	56.5892	23.23	−40	22.83	4	D	50.1327	22.78	+ 7	22.85	22.75	+42	4523.17
B	from	41.4100	4523.40	−10	4523.30							B	from	50.0990	23.60	+ 7	23.67	23.49	+43	4523.9
	B	41.4795	4524.35	− 9	4524.26													24.26	+42	4524.68
	to	41.6590	4526.90	− 9	4526.81								to	49.9980	26.90	+ 7	26.97	26.89	+42	4527.3
3	D	41.7627	4528.36	− 9	4528.27													28.27	+42	4528.69
												1	n D	49.7810	30.80	+ 7	30.87	30.87	+42	4531.29
3	n D	42.0940	4533.10	− 8	4533.02													33.02	+42	4533.44
1	n D	42.1903	4534.48	− 8	4534.40													34.40	+42	4534.82
6–8	D	42.2774	4535.73	− 8	4535.65								n D	49 5723	35.50	+ 8	35.58	35.62	+42	4536.04
												B	from	49.5480	36.10	+ 8	36.18	36.18	+42	4536.6
2	B	42.3397	4536.63	− 8	4536.55													36.55	+42	4536.97
2–3	B	42.3754	4537.14	− 8	4537.06	3	n B	55.9532	37.39	−40	36.99							37.03	+42	4537.45
5–6	n B	42.4800	4538.65	− 8	4538.57	3	B	55.8823	38.99	−40	38.59							38.58	+42	4539.00
													to	49.4000	39.50	+ 8	39.58	39.58	+42	4540.0
	wn D	42.5743	4540.01	− 8	4539.93	3	n D	55.8148	40.51	−39	40.12		nn D	49.3790	40.00	+ 8	40.08	40.04	+42	4540.46
2	n D	42.7230	4542.16	− 7	4542.09													42.09	+42	4542.51
Max	B	42.8470	4544.00	− 7	4543.93													43.93	+42	4544 4
2	n D	42.8885	4544.57	− 7	4544.50													44.50	+42	4544.92
						2	nn D	55.5850	45.72	−39	45.33	4–5	n D	49.1421	45.42	+ 9	45 51	45.42	+42	4545.84
1	n D?	43.0350	4546.70	− 7	4546.63													46.63	+42	4547.05
5–6	B	43.0724	4547.25	− 6	4247.19							4	B	49.0685	47.13	+ 9	47 22	47 21	+42	4547.63
D	from	43.1490	4548.40	− 6	4548.34													48.34	+42	4548.8
						1	nn D	55.4221	49.43	−38	49.05							49.05	+42	4549.47
	to	43.2410	4549.70	− 6	4549.64													49.64	+42	4550.1
B	from				4549.64													49.64	+42	4550.1
	Max	43.2687	4550.12	− 5	4550.07							1	B	48.9236	50.51	+10	50.61	50.34	+43	4550.77
	to	43.3860	4551.90	− 5	4551.85													51.85	+42	4552.3
						D	from	55.3080	52.00	−38	51.62							51.62	+43	4552.1
	nn D	43.4294	4552.48	− 5	4552.43													52.42	+43	4552 85
4	n D	43.5284	4553.94	− 5	4553.89								w D	48.7930	53.57	+10	53.67	53.78	+43	4551.21
							to	55.1650	55.30	−38	54.92							54 92	+43	4555.4

132 *SCHJELLERUP—Continued*

Plate A 328						Plate G 309						Plate G 368						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
1-2	n D?	43.6085	4555.12	− 5	4555.07	B												55.07	+43	4555.50
1	n D?	43.6902	4556.32	− 5	4556.27													56.27	+43	4556.70
																		56.91	+43	4557.34
3-4	nn B	43.8375	4558.50	− 5	4558.45													58.45	+43	4558.88
							to	54.9780	59.60	−37	59.23							59.23	+43	4559.7
													nn D	48.5330	59.69	+11	59.80	59.80	+43	4560.23
	nn D	44.0300	4561.36	− 4	4561.32													61.32	+43	4561.75
3	n B	44.0570	4561.76	− 4	4561.72	1	B	54.8642	62.28	−37	61.91							61.82	+43	4562.25
						2	n D	54.8214	63.27	−36	62.91	2	n D	48.3926	63.01	+12	63.13	63.02	+43	4563.45
						B	from	54.7910	64.00	−36	63.64							63.64	+43	4564.1
2	B	44.2195	4564.18	− 4	4564.14													64.14	+43	4564.57
	wn D	44.2850	4565.20	− 4	4565.16							1	n D	48.2775	65.75	+12	65.87	65.52	+43	4565.95
2	B	44.3557	4566.22	− 3	4566.19													66.19	+43	4566.62
2	n D?	44.3860	4566.67	− 3	4566.64													66.64	+43	4567.07
2-3	B	44.5149	4569.06	− 3	4569.03													69.03	+43	4569.46
							to	54.5230	70.20	−35	69.85							69.85	+43	4570.3
2	B	44.8269	4573.30	− 2	4573.28													73.28	+43	4573.71
1	n D	44.9627	4575.36	− 1	4575.35													75.35	+43	4575.78
						1	n D	54.2323	77.10	−34	76.76		w D	47.8480	76.10	+14	76.24	76.50	+43	4576.93
6	D	45.0835	4577.19	− 1	4577.18													77.18	+43	4577.61
4	B	45.1434	4578.10	− 1	4578.09	Space	from	54.1810	78.30	−34	77.96							78.09	+43	4578.52
4	B	45.2195	4579.26	− 0	4579.26													79.26	+43	4579.69
4	D	45.2700	4579.98	− 0	4579.98							1	n D	47.6864	79.77	+15	79.92	79.95	+43	4580.38
4	B	45.3184	4580.76	+ 1	4580.77													80.77	+43	4581.20
												1	n D	47.5916	82.27	+15	82.42	82.42	+43	4582.85
5	B	45.4965	4583.48	+ 1	4583.49													83.49	+43	4583.92
3	D	45.5517	4584.28	+ 1	4584.29													84.29	+43	4584.72
5	B	45.5989	4585.05	+ 2	4585.07													85.07	+43	4585.50
3	D	45.6497	4585.83	+ 2	4585.85	Unresolved B												85.85	+43	4586.28
2	B	45.6892	4586.44	+ 2	4586.46													86.46	+43	4586.89
2	D	45.7242	4586.98	+ 2	4587.00													87.00	+43	4587.43
3-4	B	45.9165	4589.94	+ 2	4589.96													89.96	+43	4590.39
4	n D	45.8625	4590.65	+ 2	4590.67													90.67	+43	4591.10
3	D	46.1562	4593.64	+ 3	4593.67													93.67	+43	4594.10
4	nn B	46.2895	4595.71	+ 4	4595.75							6	n B	47.0581	4595.36	+19	4595.55	95.65	+43	4596.08
1	n D	46.3422	4596.53	+ 4	4596.57								nn D	46.9904	4597.04	+19	4597.23	96.90	+43	4597.33
4	n B	46.5225	4599.34	+ 5	4599.39							3	B	46.9269	4598.62	+20	4598.82	99.11	+43	4599.54
4	D	46.5972	4600.52	+ 5	4600.57													00.57	+43	4601.00
4	B	46.6617	4601.52	+ 6	4601.58													01.58	+43	4602.01
2	D	46.7216	4602.46	+ 6	4602.52													02.52	+43	4602.95
						D	from	53.1590	46.0290	−29	4602.61							02.61	+43	4603.0
1	n D	46.9297	4605.73	+ 7	4605.80													05.80	+43	4606.23
													w D	46.6236	4606.19	+21	4606.40	06.40	+43	4606.83
4	n D	47.0101	4607.00	+ 7	4607.07													07.07	+43	4607.50
							to	52.9400	46.0830	−28	4608.02							08.02	+43	4608.5
B	from	47.0530	4607.70	+ 7	4607.77													07.77	+43	4608.2
																		09.52	+43	4609.95
	to	47.1575	4609.40	+ 7	4609.47													09.47	+43	4609.9
2	D	47.1800	4609.67	+ 7	4609.74													09.74	+43	4610.17
2	D	47.2515	4610.81	+ 8	4610.89													10.89	+43	4611.32
2	n B	47.2987	4611.56	+ 8	4611.64													11.64	+43	4612.07
												Max	B	46.3997	4611.83	+23	4612.06	12.06	+43	4612.49
2	n B	47.3585	4612.51	+ 8	4612.59													12.59	+43	4613.02
3-4	D	47.4129	4613.37	+ 9	4613.46								nn D	46.3442	4613.23	+23	4613.46	13.46	+43	4613.89
9	n B	47.4927	4614.64	+ 9	4614.73							4	B	46.2889	4614.65	+23	4614.88	14.80	+43	4615.23
5	D	47.5679	4615.84	+ 9	4615.93							2	D	46.2478	4615.68	+24	4615.92	15.93	+43	4616.36
1-2	B	47.6172	4616.63	+10	4616.73													16.73	+43	4617.16
6	B	47.6832	4617.68	+10	4617.78							8	B	46.1728	4617.58	+24	4617.82	17.80	+43	4618.23
2	n D	47.7640	4618.97	+10	4619.07							2	D	46.1195	4618.94	+24	4619.18	19.13	+43	4619.56
5-6	n B	47.8879	4620.98	+11	4621.09							2	B	46.0458	4620.82	+25	4621.07	21.08	+43	4621.51
4-5	B	48.0539	4623.63	+12	4623.75													23.75	+43	4624.18
1-2	B	48.1587	4625.32	+12	4625.44													25.41	+43	4625.87
2	B	48.2343	4626.54	+13	4626.67													26.67	+43	4627.10
1	n D	48.3307	4628.10	+13	4628.23													28.23	+43	4628.66
2	n D	48.4185	4629.52	+13	4629.65													29.65	+43	4630.08
2	n B	48.5152	4631.09	+14	4631.23							1	B	45.6568	4630.83	+28	4631.11	31.17	+43	4631.60
2	B?	48.6325	4633.00	+15	4633.15													33.15	+43	4633.58
1	D	48.6664	4633.56	+15	4633.71													33.71	+43	4634.14
	n D	48.8989	4637.35	+15	4637.50							1	n D	45.4289	4636.74	+29	4637.03	37.27	+43	4637.60
8	B	48.9635	4638.41	+16	4638.57							5	B	45.3652	4638.41	+30	4638.71	38.64	+43	4639.07
D	from	48.9900	4638.90	+16	4639.06													39.06	+43	4639.5
												1	D	45.3095	4639.86	+30	4640.16	40.16	+43	4640.59
	to	49.1120	4640.90	+17	4641.07													41.07	+43	4641.5
5-6	B	49.1394	4641.30	+17	4641.47													41.47	+43	4641.90
3	B	49.2263	4642.73	+17	4642.90													42.90	+43	4643.33
1	B?	49.2881	4643.75	+17	4643.92													43.92	+43	4644.35
													nn D	45.0712	4646.12	+31	4646.43	46.43	+43	4646.86
1	B	49.8122	4652.44	+20	4652.64													52.64	+44	4653.08
1	D	49.8697	4653.41	+21	4653.62													53.62	+44	4654.06
5	D	50.0139	4655.82	+21	4656.03													56.03	+44	4656.47
1	n D?	50.1154	4657.52	+23	4657.75													57.75	+44	4658.19
	n B	50.2485	4659.75	+23	4659.98													59.98	+44	4660.42
2	D?	50.2967	4660.57	+23	4660.80													60.80	+44	4661.24
2	D?	50.3763	4661.91	+23	4662.14													62.14	+44	4662.58
3	D	50.4763	4663.60	+24	4663.81	1	n D	50.7655	4663.82	−12	4663.70							63.77	+44	4664.21
3-4	B	50.5340	4664.58	+24	4664.82													64.82	+44	4665.26

132 *SCHJELLERUP—Continued*

Plate A 328						Plate G 309						Plate G 368						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
3	D?	50.5832	4665.41	+24	4665.65													65.65	+44	4666.09
2-3	n D	50.6873	4667.19	+24	4667.43													67.43	+44	4667.87
2	n D	51.5407	4681.83	+28	4682.11													82.11	+44	4682.55
....	nn D	51.8997	4688.04	+30	4688.34													88.34	+44	4688.78
1	nn B?	51.9597	4689.09	+30	4689.39													89.39	+44	4689.83
....	D	52.5544	4699.53	+32	4699.85													99.85	+44	4700.29
1	B?	52.6080	4700.47	+32	4700.79													00.79	+44	4701.23
1	n D	52.6500	4701.22	+32	4701.54													01.54	+44	4701.98
1-2	nB?	52.6903	4701.93	+32	4702.25													02.25	+44	4702.69
1	n D	52.7540	4703.06	+32	4703.38													03.38	+44	4703.82
1	D	52.8505	4704.77	+32	4705.09													05.09	+44	4705.53
1	n B?	52.8925	4705.52	+32	4705.84													05.84	+44	4706.28
2-3	B	53.0750	4708.77	+33	4709.10	1	B	49.0844	4709.49	+3	4709.52							09.31	+44	4709.75
....												D	from	42.7230	4710.50	+49	4710.99	10.99	+44	4711.4
....	wn D	53.4109	4714.78	+33	4715.11													15.11	+44	4715.55
....													to	42.5570	4715.30	+50	4715.80	15.80	+44	4716.24
3	B	53.4762	4715.97	+34	4716.31													16.31	+44	4716.75
2	D?	53.5147	4716.66	+34	4717.00													17.00	+44	4717.44
2	B	53.5527	4717.35	+34	4717.69													17.69	+44	4718.13
....	D?	53.5919	4718.06	+34	4718.40													18.40	+44	4718.84
1	B	53.6160	4718.49	+34	4718.83													18.83	+44	4719.27
....	D?	53.6527	4719.15	+34	4719.49													19.49	+44	4719.93
	B	53.6892	4719.81	+34	4720.15													20.15	+44	4720.59
	wn D	53.8110	4722.02	+34	4722.36	2	n D	48.6384	4722.04	+6	4722.10							22.23	+44	4722.67
Con. Spec.	from	53.8460	4722.66	+34	4723.00													23.00	+44	4723.4
	to	54.0790	4726.90	+35	4727.25													27.25	+44	4727.7
....	w D	54.2185	4729.45	+36	4729.81													29.81	+44	4730.25
2	n B	54.2942	4730.83	+36	4731.19													31.19	+44	4731.63
1	n D	54.3422	4731.71	+36	4732.07													32.07	+44	4732.51
10	D	54.5738	4735.97	+36	4736.33	....	wn D	48.1631	4735.61	+9	4735.70	10	D	41.8619	4735.39	+55	4735.94	35.99	+44	4736.43
....						B	from	48.1010	4737.40	+9	4737.49	B	from	41.8190	4736.70	+55	4737.25	37.37	+44	4737.8
7	B	54.6845	4738.02	+37	4738.39		B	48.0691	4738.33	+9	4738.42		Max	41.7834	4737.70	+55	4738.25	38.35	+44	4738.79
....	n D	54.7300	4739.03	+37	4739.40													39.40	+44	4739.84
4-5	n B	54.8032	4740.27	+37	4740.64													40.64	+44	4741.08
....							to	47.9380	4742.10	+10	4742.20		to	41.6560	4741.50	+56	4742.06	42.13	+44	4742.6
10	D	54.9734	4743.38	+37	4743.75	....	w D	47.8895	4743.53	+10	4743.63	....	w D	41.6095	4742.83	+57	4743.40	43.56	+44	4744.00
	Head	55.0210	4744.26	+37	4744.63							....	Head	41.5589	4744.33	+57	4744.90	44.77	+44	4745.21
7	n B	55.0912	4745.57	+37	4745.94													45.94	+44	4746.38
....	n D?	55.1478	4746.62	+37	4746.99													46.88	+44	4747.32
6	n B	55.1952	4747.51	+37	4747.88													47.88	+44	4748.32
2-3	n D	55.2522	4748.58	+38	4748.96													48.96	+44	4749.40
4	n B	55.3075	4749.61	+38	4749.99													49.99	+44	4750.43
5	n B	55.5588	4754.33	+38	4754.71													54.71	+45	4755.16
....	n D	55.6065	4755.23	+38	4755.61													55.61	+45	4756.06
3	n B	55.6527	4756.10	+38	4756.48													56.48	+45	4756.93
3	n B	55.8185	4759.24	+38	4759.62													59.62	+45	4760.07
1	n D?	55.8737	4760.29	+39	4760.68													60.68	+45	4761.13
....	n B	55.9689	4762.09	+39	4762.48													62.48	+45	4762.93
....	nn D?	56.0145	4762.96	+39	4763.35													63.35	+45	4763.78
....	nn D	56.1545	4765.63	+39	4766.02													66.02	+45	4766.47
2	n B?	56.3755	4769.86	+39	4770.25													70.25	+45	4770.70
....	nn D?	56.4092	4770.50	+39	4770.89													70.89	+45	4771.34
....	nn D	56.4759	4771.79	+39	4772.18							1-2	nn D	40.6446	4771.83	+63	4772.46	72.32	+45	4772.77
....	n B	56.5880	4773.94	+39	4774.33													74.33	+45	4774.78
....	nn D	57.0985	4783.83	+40	4784.23	1	n D	46.5200	4784.29	+13	4784.42							84.33	+45	4784.78
2-3	D	57.3350	4788.46	+40	4788.86	1	n D	46.3532	4789.39	+13	4789.52	1	n D	40.1024	4788.63	+66	4789.29	89.22	+45	4789.67
....												....	wn D	39.5773	4805.16	+69	4805.85	05.85	+45	4806.30
2-3	n D	58.6530	4814.66	+40	4815.06	1-2	n D	45.5132	4815.53	+10	4815.63	1-2	n D	39.2701	4815.08	+69	4815.77	15.48	+45	4815.93
	nn D	59.0539	4822.88	+40	4823.28	1	n D	45.2591	4823.58	+9	4823.67	1	D	39.0250	4822.89	+69	4823.58	23.51	+45	4823.96
B	from	59.1050	4823.82	+40	4824.22							1-2						24.22	+45	4824.7
												2	B	38.9626	4824.91	+69	4825.60	25.60	+45	4826.05
	to	59.2190	4826.20	+40	4826.60													26.60	+45	4827.1
2	nn D	59.2528	4826.84	+40	4827.24	1	n D	45.1254	4827.86	+8	4827.94	1	D	38.8879	4827.36	+69	4828.05	27.74	+45	4828.19
4	B	59.3755	4829.35	+40	4829.75							2	B	38.8282	4829.29	+68	4829.97	29.86	+45	4830.31
3	D	59.4695	4831.29	+40	4831.69	3	n D	44.9958	4832.01	+8	4832.09	1	D	38.7728	4831.10	+68	4831.78	31.85	+45	4832.30
B	from	59.5120	4832.20	+40	4832.60													32.60	+45	4833.1
	to	59.7850	4837.80	+39	4838.19													38.19	+45	4838.6
1	n D	59.8160	4838.43	+39	4838.82							0-1	D	38.5475	4838.50	+68	4839.18	39.00	+45	4839.45
1	n D	60.0194	4842.66	+39	4843.05													43.05	+45	4843.50
5	n B?	60.3192	4848.92	+39	4849.31							2	B	38.2271	4849.12	+66	4849.78	49.55	+45	4850.00
1	n D	60.3977	4850.56	+38	4850.94													50.94	+46	4851.40
....	nn D	60.5772	4854.35	+38	4854.73													54.73	+46	4855.19
B	from	60.6150	4855.20	+38	4855.58													55.58	+46	4856.0
												Max	B	38.0023	4856.66	+65	4857.31	57.31	+46	4857.77
	to	60.7540	4858.10	+38	4858.48													58.48	+46	4858.9
1	n D	60.7717	4858.45	+38	4858.83													58.83	+46	4859.29
1	n D	61.1694	4866.91	+37	4867.28													67.28	+46	4867.74
3	n B	61.2407	4868.43	+37	4868.80													68.80	+46	4869.26
....	wn D	61.3192	4870.12	+37	4870.49	2	n D	43.8034	4871.20	+1	4871.21	1-2	n D	37.5917	4870.57	+63	4871.20	70.97	+46	4871.43
2-3	n D	61.5232	4874.50	+36	4874.86	2	n D	43.6862	4875.14	0	4875.14	1-2	D	37.4751	4874.56	+62	4875.18	75.06	+46	4875.52
5	wn B	61.7147	4878.64	+35	4878.99													78.99	+46	4879.45
5	D	61.7979	4880.44	+35	4880.79	2	n D	43.5099	4881.15	−1	4881.14	2-3	D	37.2970	4880.69	+60	4881.29	81.07	+46	4881.53
1	nn D	62.2437	4890.46	+33	4890.49	2	n D	43.2250	4890.83	−3	4890.80							90.65	+46	4891.11
....										1		Max	B	36.8043	4897.86	+58	4898.44	98.44	+46	4898.90
2	n D	62.6704	4899.56	+31	4899.87	1-2	n D	42.9421	4900.59	−5	4900.54							00.21	+46	4900.67
1	nu D	63.0839	4908.76	+29	4909.05	1	nn D	42.6787	4909.76	−7	4909.69							09.37	+46	4909.83

132 *SCHJELLERUP — Continued*

Plate A 328						Plate G 309						Plate G 368						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
D	from	63.5110	4918.35	+27	4918.62	....	......	....	....	....	....	....	....	....	....	....	....	18.62	+46	4919.1
	......	....	....	....	....	4	wn D	42.3836	4920.15	−9	4920.06	....	....	....	....	....	....	20.06	+46	4920.52
	to	63.6190	4920.80	+27	4921.07	....	......	....	....	....	....	....	....	....	....	....	....	21.07	+46	4921.5
1	nn D	63.7550	4923.87	+26	4924.13	1	n D	42.2439	4925.10	−10	4925.00	....	....	....	....	....	....	24.57	+46	4925.03
3	n D	64.1451	4932.78	+24	4933.02	2-3	n D	41.9972	4933.93	−11	4933.84	2	n D	35.8181	4933.19	+50	4933.69	33.55	+46	4934.01
		Strong continuous spectrum				2	n D	41.3424	4957.74	−16	4957.58	....	....	....	....	....	....	57.58	+47	4958.05
....	......	....	....	....	....	1	n D	40.7751	4979.61	−20	4979.41	....	....	....	....	....	....	79.41	+47	4979.88
....	wn D?	66.2155	4981.45	+10	4981.55	....	......	....	....	....	....	....	....	....	....	....	....	81.55	+47	4982.02
....	nn D?	66.5620	4989.90	+7	4989.97	....	......	....	....	....	....	....	....	....	....	....	....	89.97	+47	4990.44
2	n D?	66.9005	4998.33	+5	4998.38	1	n D	40.2257	4999.75	−23	4999.52	....	....	....	....	....	....	99.95	+47	5000.42
1	n D?	67.2257	5006.11	+3	5006.14	....	......	....	....	....	....	....	....	....	....	....	....	06.14	+47	5006.61
...	nn D?	67.3613	5009.47	+2	5009.49	....	......	....	....	....	....	....	....	....	....	....	....	09.49	+47	5009.96
....	nn D?	67.5384	5013.87	+0	5013.87	....	......	....	....	....	....	....	....	....	....	....	....	13.87	+47	5014.34
	End	68.1330	5036.40	−6	5036.3		End	39.3502	5034.00	−30	5033.70		End	33.5580	5019.1	+30	5019.4	.....	....	....

132 *SCHJELLERUP*

Plate G 299 1899, March 5, G.M.T. 17h8. Hour angle, W 0h3 Star good; comparison fair						Plate G 301 1899, March 6, G.M.T. 19h0. Hour angle, W 1h5 Star excellent; comparison excellent						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
Head	....	46.5140	5167.70	+13	5167.83	Head	....	47.1560	5167.10	+17	5167.27	67.55	+49	5168.04
2	n D?	46.4342	5172.02	+11	5172.13	5	n D	47.0198	5172.46	+13	5172.59	72.36	+49	5172.85
D	from	46.2150	5180.70	+8	5180.78	...	....	....	....	....	....	80.68	+49	5181.2
	....	....	....	....	....	...	wn D	46.7500	5183.10	+7	5183.17	83.27	+49	5183.8
	to	46.1120	5184.70	+7	5184.77	...	....	....	....	....	....	84.67	+49	5185.2
...	....	....	....	....	....	B	from	46.7040	5184.90	+7	5184.97	84.87	+49	5185.4
1	n D	46.0144	5188.77	+7	5188.84	1	nn D	46.6120	5188.58	+6	5188.64	88.74	+49	5189.23
	....	....	....	....	....		to	46.5470	5191.20	+6	5191.26	91.36	+49	5191.9
2	nn D	45.9239	5192.41	+6	5192.47	4	n D	46.5116	5192.57	+5	5192.62	92.55	+49	5193.04
..	....	....	....	....	....	B	from	46.4840	5193.68	+5	5193.73	93.83	+49	5194.3
D	from	45.6500	5203.50	+3	5203.53		to	46.2350	5203.68	0	5203.68	03.61	+49	5204.1
	to	45.4680	5211.00	+1	5211.01	D	to	46.0110	5211.54	−3	5211.51	11.31	+49	5211.8
1	nn D	45.3440	5216.05	−1	5216.04	1	nn D	45.9298	5216.06	−5	5216.01	16.03	+49	5216.52
...	n D	45.0836	5226.83	−4	5226.79	5	D	45.6663	5226.88	−9	5226.79	26.79	+49	5227.28
2	n D	44.9239	5233.49	−6	5233.43	4	n D	45.5059	5233.51	−11	5233.40	33.42	+49	5233.91
1	n B	44.8580	5236.30	−7	5236.23	Max	B	45.4470	5235.95	−12	5235.83	36.03	+49	5236.52
..	....	....	....	....	....	1	n D	45.3657	5239.33	−13	5239.20	39.30	+49	5239.79
2-3	n D	44.5993	5247.16	−10	5247.06	3	n D	45.1846	5246.92	−15	5246.77	46.92	+49	5247.41
2-3	n D	44.5010	5251.20	−12	5251.08	3	D	45.0872	5251.01	−17	5250.84	50.96	+50	5251.46
...	....	....	....	....	....	1	nn D	44.9889	5255.17	−17	5255.00	55.10	+50	5255.60
4	n D	44.0566	5270.38	−19	5270.19	5	D	44.6147	5269.82	−20	5269.62	69.91	+50	5270.41
...	....	....	....	....	....	1–2	B	44.4300	5279.07	−21	5278.86	78.96	+50	5279.46
1	nn D	43.7500	5283.71	−21	5283.50	...	....	....	....	....	....	83.10	+50	5283.90
3	n D	43.4253	5297.99	−24	5297.75	3	D	44.0032	5297.67	−20	5297.47	97.61	+50	5298.11
1	n D	43.3304	5302.20	−25	5301.95	...	....	....	....	....	....	01.85	+50	5302.35
...	....	....	....	....	....	1	B	43.6564	5313.01	−18	5312.83	12.93	+50	5313.43
2	n D	43.0101	5315.16	−27	5314.89	1	n D	43.6151	5314.85	−18	5314.67	14.78	+50	5315.28
...	....	....	....	....	....	2	B	43.5594	5317.34	−18	5317.16	17.26	+50	5317.76
3	wn D	42.9105	5321.01	−28	5320.73	...	....	....	....	....	....	20.63	+50	5321.13
3-4	n D	42.7342	5329.00	−29	5328.71	1	n D	43.3009	5328.55	−15	5328.40	28.56	+50	5329.06
1	n D	42.5628	5336.81	−29	5336.52	1	nn D	43.1490	5335.84	−13	5335.71	36.32	+50	5336.82
2-3	n D	42.4548	5341.77	−30	5341.47	2	n D	43.0378	5340.90	−11	5340.79	41.13	+50	5341.63
...	....	....	....	....	....	1	B	42.7960	5352.00	−8	5351.92	52.02	+50	5352.52
1	n D	41.9991	5362.90	−31	5362.59	...	....	....	....	....	....	62.49	+50	5362.99
2	n D	41.9202	5366.60	−31	5366.29	1	nn D	42.4895	5366.20	−6	5366.14	66.22	+50	5366.72
2	B	41.8669	5369.10	−31	5368.79	2	B	42.4432	5368.36	−5	5368.31	68.55	+50	5369.05
9	D	41.8114	5371.71	−31	5371.40	10	D	42.3777	5371.42	−5	5371.37	71.39	+50	5371.89

132 *SCHJELLERUP—Continued*

Plate G 299						Plate G 301						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
3	n B	41.7405	5375.06	−31	5374.75	6	B	42.3104	5374.59	− 4	5374.55	74.65	+50	5375.15
1	n D	41.6927	5377.32	−31	5377.01	1	n D	42.2612	5376.90	− 4	5376.86	76.94	+50	5377.44
n	n B	41.6281	5380.38	−32	5380.06	...	....	....	....	....	....	79.96	+50	5380.46
1	n D	41.5478	5484.20	−32	5383.88	1	n D	42.1056	5384.25	− 3	5381.22	81.05	+50	5384.55
...	....	....	....	....	....	1	nn D	41.8301	5397.38	− 1	5397.37	97.47	+50	5397.97
...	....	....	....	....	....	1	nn D	41.6445	5406.30	0	5406.30	06.40	+50	5406.90
2	n D	41.0046	5410.35	−32	5410.03	2	D	41.5651	5410.14	0	5410.14	10.09	+50	5410.59
...	....	....	....	....	....	1–2	B	41.5310	5411.79	0	5411.79	11.89	+50	5412.39
1	nn D	40.9277	5414.10	−32	5413.78	1–2	n D	41.4980	5413.39	+ 1	5413.40	13.59	+50	5414 09
4	B	40.8673	5417.05	−32	5416.73	5	n B	41.4366	5416.38	+ 1	5416.39	16.56	+50	5417.06
6	wn D	40.7959	5420.55	−32	5420.23	2	D	41.3703	5419.61	+ 1	5419.62	19.93	+50	5420.43
...	....	....	....	....	....	3	n B	41.3123	5422.44	+ 1	5422.45	22.55	+50	5423.05
1	n D	40.7109	5424.73	−32	5424.42	2	n D	41.2679	5424.62	+ 2	5424.64	24.53	+59	5425.03
3	n D	40.5995	5430.23	−31	5429.92	4	D	41.1642	5429.72	+ 2	5429.71	29.83	+50	5430.33
...	....	....	....	....	....	3	B	41.1254	5431.63	+ 2	5431.65	31.75	+50	5432.25
1	nn D	40.5200	5434.17	−31	5433.86	2	n D	41.0808	5433.82	+ 2	5433.84	33.85	+50	5434.35
7	D	40.2479	5447.74	−30	5447.44	9	D	40.8159	5446.99	+ 3	5447.02	47.23	+50	5447.73
Max	B	40.1815	5451.08	−30	5450.78	Max	B	40 7560	5449.98	+ 3	5450.01	50.40	+51	5450.91
3	n D	40.0686	5456.77	−30	5456.47	2 3	D	40.6298	5456.32	+ 3	5456.35	56.41	+51	5456.92
1	n D	39.9823	5461.14	−29	5460.85	2	n D	40.5554	5460.07	+ 4	5460.11	60.48	+51	5460.99
1	n D	39.8744	5466.63	−29	5466.34	...	....	....	....	....	....	66.24	+51	5466.75
3	n B	39.7607	5472.43	−28	5472.15	3	B	40.3283	5471.59	+ 4	5471.63	71.89	+51	5472.40
...	....	....	....	....	....	1	n D	40.2899	5473.55	+ 4	5473.59	73.69	+51	5474.20
...	....	....	....	....	....	1 2	n D	40.2149	5477.39	+ 4	5477.43	77.53	+51	5478.04
1	n D	39.5595	5482.77	−28	5482.49	1	n D	40.1169	5482.42	+ 4	5482.46	82.48	+51	5482.99
1	B	39.3182	5495.29	−26	5495.03	2	B	39.8698	5495.19	+ 5	5495.24	95.14	+51	5495.65
5	D	39.2723	5497.68	−26	5497.42	5	D	39.8283	5497.35	+ 5	5497.40	97.41	+51	5497.92
...	....	....	....	....	....	4	n D	39.7458	5501.65	+ 5	5501.70	01.80	+51	5502.31
...	....	....	....	....	....	1	n D	39.6583	5506.23	+ 5	5506.28	06.38	+51	5506.89
...	....	....	....	....	....	2	wn B	39.6205	5508.22	+ 5	5508.27	08.37	+51	5508.88
1-2	n D	38.9961	5512.19	−24	5511.95	2 3	nn D	39.5505	5511.90	+ 5	5511.95	11.95	+51	5512.46
Con. Spec.	from	38.9720	5513.50	−24	5513.26	Con. Spec.	from	39.5240	5513.30	+ 5	5513.35	13.31	+51	5513.82
	to	38.7880	5523.20	−23	5522.97		to	39.3530	5522.36	+ 4	5522.40	22.69	+51	5523.2
1	n D	38.7687	5524.26	−23	5524.03	...	nn D	39.3288	5523.63	+ 4	5523.67	23.85	+51	5524.36
1	nn D	38.7000	5527.90	−22	5527.68	...	....	....	....	....	....	27.58	+51	5528.09
1	n D	38.5912	5533.76	−21	5533.55	1	n D	39.1515	5533.10	+ 4	5533.14	33.35	+51	5533.86
9	D	38.4818	5539.65	−20	5539.45	7	D	39.0395	5539.11	+ 4	5539.15	39.30	+51	5539.81
...	....	....	....	....	....	B	from	39.0080	5544.00	+ 4	5544.04	41.14	+51	5544.7
2-3	n B	38.4125	5543.40	−20	5543.20		....	....	....	....	....	43.10	+51	5543.61
...	....	....	....	....	....		to	38.9110	5546.10	+ 4	5546.14	46.24	+51	5546.8
1	n D	38.3335	5547.68	−19	5547.49	1–2	D	38.8841	5547.51	+ 4	5547.55	47.52	+51	5548.03
1	n D	38.1797	5556.06	−18	5555.88	...	....	....	....	....	....	55.78	+51	5556.30
...	....	....	....	....	....	1	nn D	38.6247	5561.55	+ 3	5561.58	61.68	+52	5562.20
1	n B	38.0298	5564.29	−16	5564.13	1–2	n B	38.5843	5563.87	+ 3	5563.90	64.02	+52	5564.54
1	n D	37.9876	5566.61	−16	5566.45	1	nn D	38.5429	5566.15	+ 3	5566.18	66.32	+52	5566.84
1	n B	37.9020	5571.34	−15	5571.19	2	B	38.4535	5571.07	+ 2	5571.09	71.14	+52	5571.66
...	....	....	....	....	....	1	nn D	38.4240	5572.71	+ 2	5572.73	72.83	+52	5573.4
...	....	....	....	....	....	1	n D	38.3669	5575.86	+ 2	5575.88	75.98	+52	5576.50
9	D	37.6804	5583.65	−13	5583.52	9	D	38.2360	5583.14	+ 1	5583.15	83.34	+52	5583.86
2	B	37.6268	5586.65	−12	5586.53	4	B	38.1785	5586.35	+ 1	5586.36	86.45	+52	5586.97
1	nn D	37.5900	5588.70	−12	5588.58	1	n D	38.1459	5588.17	+ 1	5588.18	88.38	+52	5588.90
1	nn B	37.5402	5591.51	−11	5591.40	...	....	....	....	....	....	91.30	+52	5591.82
1	nn D	37.5002	5593.76	−11	5593.65	1	n D	38.0398	5594.13	0	5594.13	93.89	+52	5594.41
2	nn B	37.4529	5596.42	−10	5596.32	2–3	n B	37.9992	5596.41	0	5596.41	96.37	+52	5596.89
1–2	nn D	37.3884	5600.07	− 9	5599.98	1	n D	37.9477	5599.31	0	5599.31	99.65	+52	5600.17
1	nn D	37.2338	5608.84	− 7	5608.77	2	n D	37.7891	5608.30	− 1	5608.29	08.53	+52	5609.05
Con.	from	37.2150	5609.90	− 7	5609.83	...	....	....	....	....	....	09.73	+52	5610.3
...	....	....	....	....	....	1	n D	37.6748	5614.82	− 2	5614.80	14.90	+52	5615.42
...	....	....	....	....	....	1–2	n B	37.6452	5616.51	− 2	5616.49	16.59	+51	5617.11
Spec.	to	37.0760	5617.84	− 5	5617.79	...	....	....	....	....	....	17.69	+52	5618.2
...	D	37.0440	5619.68	− 5	5619.63	3	n D	37.5958	5619.35	− 2	5619.33	19.48	+52	5620.00
...	D	36.9600	5624.51	− 3	5624.48	4	D	37.5195	5623.73	− 3	5623.70	24.09	+52	5624.61
Con.	from	36.9290	5626.30	− 3	5626.27	Con.	from	37.4820	5625.90	− 3	5625.87	26.07	+52	5626.6
Spec.	to	36.8510	5630.80	− 2	5630.78	Spec.	to	37.3930	5631.10	− 3	5631.07	30.93	+52	5631.5
10	D	36.8072	5633.35	− 1	5633.34	10	D	36.3548	5633.24	− 4	5633.20	33.27	+52	5633.79

132 *SCHJELLERUP—Continued*

PLATE G 299						PLATE G 301						MEAN WAVE-LENGTH		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
	Head	36.7553	5636.36	−1	5636.35	...	Head	37.3100	5635.84	−4	5635.80	36.08	+52	5636.60
1-2	n B	36.7356	5637.54	0	5637.54	3-4	n B	37.2867	5637.19	−4	5637.15	37.35	+52	5637.87
1	n D	36.7105	5638.97	0	5638.97	...	....	....	....	....	....	38.87	+52	5639.39
1-2	n B	36.6836	5640.54	+1	5640.55	3-4	n B	37.2398	5639.93	−4	5639.89	40.22	+52	5640.74
...	wn D	36.6307	5643.63	+2	5643.65	...	nn D	37.1849	5643.13	−5	5643.08	43.37	+52	5643.89
...	....	....	....	....	....	1-2	n B	37.1431	5645.58	−5	5645.53	45.63	+52	5646.15
...	....	....	....	....	....	1	n B	36.9852	5654.85	−6	5654.79	54.89	+53	5655.42
...	....	....	....	....	....	1	n D	36.9128	5657.36	−6	5657.30	57.40	+53	5657.93
1	n D	36.1689	5670.90	+10	5671.00	1	nn D	36.7302	5669.97	−6	5669.91	70.46	+53	5670.99
1	n D	36.0795	5676.24	+12	5676.36	1	nn D	36.6357	5675.61	−7	5675.54	75.95	+53	5676.48
1	nn D	35.9256	5685.49	+15	5685.64	1	nn D	36.4636	5685.96	−8	5685.88	85.76	+53	5686.29
4	n B	35.8405	5692.45	+17	5692.62	4	B	36.3503	5692.82	−9	5692.73	92.68	+53	5693.21
...	....	....	....	....	....	1	nn D	36.2948	5696.19	−10	5696.09	96.19	+53	5696.72
2	n B	35.6228	5703.87	+21	5704.08	4	B	36.1661	5704.04	−11	5703.93	01.00	+53	5704.53
1-2	n D	35.5629	5707.54	+22	5707.76	2	n D	36.1056	5707.75	−11	5707.64	07.70	+53	5708.23
...	....	....	....	....	....	1	B	36.0658	5710.19	−11	5710.08	10.18	+53	5710.71
1	nn D	35.4974	5711.56	+23	5711.79	2	n D	36.0375	5711.94	−12	5711.82	11.80	+53	5712.33
	from	35.4660	5713.50	+20	5713.70	...	....	....	....	....	....	13.60	+53	5714.1
B	....	....	....	....	....	5	nn B	35.9747	5715.80	−12	5715.68	15.78	+53	5716.31
	to	35.3790	5718.90	+30	5719.20	...	....	....	....	....	....	19.10	+53	5719.6
1	n D	35.3173	5720.82	+30	5721.12	...	....	....	....	....	....	21.02	+53	5721.6
2-3	B	35.3117	5723.02	+30	5723.32	4	nn B	35.8461	5723.76	−13	5723.62	23.47	+53	5724.00
3-4	n D	35.1870	5730.80	+30	5731.10	2	D	35.7394	5730.41	−14	5730.27	30.19	+53	5730.72
B	from	35.1570	5732.70	+40	5733.10	B	from	35.7450	5732.00	−14	5731.86	32.5	+53	5733.0
	to	35.0290	5740.60	+40	5741.00		to	35.5750	5740.80	−15	5740.65	40.83	+53	5741.4
1	nn D	34.9955	5742.77	+40	5743.17	...	....	....	....	....	....	43.07	+53	5743.60
1	nn D	34.9234	5749.30	+40	5749.70	2	n D	35.4554	5748.25	−16	5748.09	48.90	+53	5749.43
...	....	....	....	....	....	2	n D	35.2506	5761.26	−18	5761.08	61.18	+54	5761.72
...	....	....	....	....	....	1-2	B	35.1708	5766.37	−19	5766.18	66.28	+54	5766.82
2	n D	34.5817	5769.03	+40	5769.43	...	w D	35.1245	5769.34	−19	5769.15	69.25	+54	5769.79
	from	34.5550	5770.70	+40	5771.10	...	....	....	....	....	....	71.00	+54	5771.5
B	....	....	....	....	....	1-2	B	35.0553	5773.79	−20	5773.59	73.69	+54	5774.23
	....	....	....	....	....	1-2	B	34.9712	5779.22	−21	5779.01	79.11	+54	5779.65
	to	34.4090	5780.10	+40	5780.50	...	....	....	....	....	....	80.40	+54	5780.9
...	....	....	....	....	....		from	34.9520	5780.50	−21	5780.29	80.39	+54	5780.9
...	D	34.3690	5782.70	+40	5783.10	D	....	....	....	....	....	83.00	+54	5783.5
...	....	....	....	....	....		to	34.8620	5786.30	−22	5786.08	86.18	+54	5786.7
...	....	....	....	....	....	1	nn D	34.8260	5788.70	−22	5788.48	88.58	+54	5789.1
...	....	....	....	....	....	1	nn D	34.7620	5792.90	−23	5792.67	92.77	+54	5793.3
1	nn D	34.1639	5796.06	+1. ±	5797.	1	n D	34.6951	5797.20	−24	5796.96	97.06	+54	5797.60
...	....	....	....	....	....	1	n D	34.6066	5803.00	−25	5802.75	02.85	+54	5803.39
1	D	34.0431	5803.96	+1. ±	5805.	...	....	....	....	....	....	05.	+54	5806.
...	....	....	....	....	....	2	n D	34.3239	5821.74	−27	5821.47	21.57	+54	5822.11
...	....	....	....	....	....	1	n D	34.2052	5829.68	−29	5829.39	29.49	+54	5830.03
...	....	....	....	....	....	Max	B	34.0230	5842.00	−30	5841.70	41.80	+54	5842.34
	End	32.9740	5876.0	+1. ±	5876.		End	33.3700	5886.90	−30	5886.60	.....	....	....

115 *SCHJELLERUP*

PLATE G 363 1899, December 26, G.M.T. 21h0. Hour angle, W 1h0 Star poor; comparison fair						PLATE G 382 1900, January 31, G.M.T. 19h3. Hour angle, W 1h7 Star fair; comparison fair						MEAN WAVE-LENGTH		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	...	nn D	55.3980	4404.82	−11	4404.71	04.73	+19	4404.92
...	....	....	....	....	....	4	n D	55.3004	4407.81	−12	4407.69	07.71	+19	4407.90
...	....	....	....	....	....	1	n D	55.0060	4416.87	−15	4416.72	16.74	+19	4416.93
...	....	....	....	....	....	4-5	wn D	54.4137	4435.46	−20	4435.26	35.28	+19	4435.47

115 *SCHJELLERUP — Continued*

Plate G 363						Plate G 382						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	3	n B	54.3122	4438.70	−20	4438.50	38.52	+19	4438.71
...	....	....	....	....	....	2–3	wn D	53.9600	4450.04	−23	4449.81	49.83	+19	4450.02
...	....	....	....	....	....	...	n D	53.5890	4462.18	−24	4461.94	61.96	+20	4462.2
...	....	....	....	....	....	1	D	53.3279	4470.87	−24	4470.63	70.65	+20	4470.85
...	....	....	....	....	....	2	n B	53.2443	4473.67	−24	4473.43	73.45	+20	4473.65
1	n B	50.5985	4478.12	+28	4478.40	...	....	....	....	....	....	78.38	+20	4478.58
...	....	....	....	....	....	2	n B	52.9343	4484.15	−24	4483.91	83 93	+20	4484.13
...	....	....	....	....	....	2	n D	52.9075	4485.07	−24	4484.83	84.85	+20	4485.05
...	....	....	....	....	....	2	n B	52.8835	4485.89	−24	4485.65	85.67	+20	4485.87
1	n D	50.0670	4496.57	+25	4496.82	1–2	n D	52.5580	4497.09	−23	4496.86	96.84	+20	4497.04
1	nn D	49.9557	4500.49	+24	4500.73	...	....	....	....	....	....	00.71	+20	4500.91
...	....	....	....	....	....	1	n B	52.3616	4503.92	−23	4503.69	03.71	+20	4503.91
1–2	n D	49.7954	4506.18	+24	4506.42	2	n D	52.2772	4506.89	−23	4506.66	06.54	+20	4506.74
...	....	....	....	....	....	3	n B	52.2392	4508.22	−23	4507.99	08.01	+20	4508.21
...	....	....	....	....	....	1–2	nn D	52.1026	4513.05	−22	4512.83	12.85	+20	4513 05
...	....	....	....	....	....	1 2	n D	51.9575	4518.20	−21	4517.99	18.01	+20	4518.21
...	nn D	49.3424	4522.48	+22	4522.70	2–3	n D	51.8164	4523.25	−20	4523.05	22.88	+20	4523.08
...	....	....	....	....	....	3	n B	51.7799	4524.57	−20	4524.37	24.39	+20	4524.59
...	....	....	....	....	....	...	n D	51.6999	4527.45	−19	4527.26	27.28	+20	4527.48
...	nn D	48.9980	4535.11	+21	4535.32	...	n D	51.4760	4535.58	−18	4535.40	35.36	+20	4535.56
...	n B	48.9534	4536.76	+21	4536.97	...	n B	51.4330	4537.16	−17	4536.99	36.98	+20	4537.08
...	....	....	....	....	....	1	B	51.3933	4538.61	−17	4538.44	38.46	+20	4538.66
...	....	....	....	....	....	1	B	51.1457	4547.74	−15	4547.59	47.61	+20	4547.81
...	wn D	48.5380	4552.31	+20	4552.51	...	....	....	....	....	....	52.49	+20	4552.69
...	....	....	....	....	....	4	n D	50.9777	4554.00	−13	4553.87	53.89	+20	4554.09
...	nn D	48.3365	4559.97	+20	4560.17	...	....	....	....	....	....	60.15	+20	4560.35
B	from	48.1690	4566.39	+20	4566.59	...	....	....	....	....	....	66.57	+20	4566.8
	to	48.1020	4568.97	+20	4569.17	...	....	....	....	....	....	69.15	+20	4569.4
0–1	B	47.9985	4572.98	+20	4573.18	...	....	....	....	....	....	73.16	+20	4573.36
D	from	47.9890	4573.35	+20	4573.55	...	....	....	....	....	....	73.53	+20	4573.7
	to	47.9000	4576.81	+20	4577.01	...	....	....	....	....	....	76.99	+20	4577.2
...	....	....	....	....	....	...	nn D	50.0410	4589.87	+ 4	4589.91	89.93	+20	4590.13
1	n D	47.5459	4590.75	+21	4590.96	...	....	....	....	....	....	90.94	+20	4591.14
...	nn D	47.4864	4593.12	+21	4593.33	...	....	....	....	....	....	93.31	+20	4593.51
0–1	n D	47.4005	4596.55	+21	4596.76	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	...	nn D	49.8490	4597.44	+ 8	4597.52	97.14	+20	4597.34
...	....	....	....	....	....	1	nn D	49.7752	4600.37	+ 9	4600.46	00.48	+20	4600.68
...	....	....	....	....	....	D	from	49.6580	4605.04	+12	4605.16	05.18	+20	4605.4
2–3	n D	47.1697	4605.84	+22	4606.06		....	....	....	....	....	06.04	+20	4606.24
...	....	....	....	....	....		to	49.5790	4608.20	+12	4608.32	08.34	+20	4608.5
1–2	n D	47.0049	4612.53	+22	4612.75	...	....	....	....	....	....	12.71	+20	4612.91
...	....	....	....	....	....	3	n B	49.3524	4617.36	+16	4617.52	17.54	+20	4617.74
1	n D	46.8450	4619.08	+22	4619.30	2	n D	49.3124	4618.98	+16	4619.14	19.22	+20	4619.42
...	....	....	....	....	....	2	n D	49.2172	4622.87	+17	4623.04	23.06	+20	4623.26
...	....	....	....	....	....	1–2	n B	48.8429	4638.32	+24	4638.56	38.58	+20	4638.78
...	....	....	....	....	....	1–2	nn D	48.8047	4639.91	+24	4640.15	40.17	+20	4640.37
...	nn D	45.7074	4667.27	+28	4667.55	...	....	....	....	....	....	67.53	+20	4667.73
...	....	....	....	....	....	1–2	n D	47.9970	4674.37	+33	4674.70	74.72	+20	4674.92
1	n D	45.0400	4696.91	+34	4697.25	...	....	....	....	....	....	97.21	+20	4697.41
...	....	....	....	....	....	0–1	D	46.9420	4721.68	+39	4722.07	22.09	+20	4722.29
...	....	....	....	....	....	1	D	46.7818	4729.10	+39	4729.49	29.51	+20	4729.71
...	nn D	44.2260	4734.51	+40	4734.91	...	....	....	....	....	....	34.89	+20	4735.09
3	n B	44.1447	4738.36	+41	4738.77	4	B	46.5858	4738.27	+39	4738.66	38.72	+20	4738.92
1	n D	44.1187	4739.60	+41	4740.01	...	....	....	....	....	....	39.99	+20	4740.19
10	D	44.0418	4743.26	+42	4743.68	10	w D	46.4882	4742.87	+39	4743.26	43.47	+20	4743.67
Head	....	44.0112	4744.72	+42	4745.14	Head	....	46.4447	4744.93	+39	4745.32	45.23	+20	4745.43
B	....	....	....	....	....	4–5	B	46.4204	4746.09	+39	4746.48	46.50	+20	4746.70
	to	43.9450	4747.88	+42	4748.30	...	....	....	....	....	....	48.28	+20	4748.5
...	nn D	43.9240	4748.89	+42	4749.31	...	....	....	....	....	....	49.29	+20	4749.49
...	nn D	43.8658	4751.69	+42	4752.01	...	....	....	....	....	....	51.99	+21	4752.20
...	nn B	43.8075	4754.50	+42	4754.92	...	....	....	....	....	....	54.90	+21	4755.11
...	....	....	....	....	....	...	nn B	46.2173	4755.78	+39	4756.17	56.19	+21	4756 40
...	nn D	43.7227	4758.61	+43	4759.04	...	wn D	46.1725	4757.94	+39	4758.33	58.69	+21	4758.90
...	nn D	43 5640	4766.35	+44	4766.79	...	....	....	....	....	....	66.77	+21	4766.98

115 *SCHJELLERUP — Continued*

Plate G 363						Plate G 382						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	nn D	43.4590	4771.50	+44	4771.94	2	n D	45.8917	4771.56	+37	4771.93	71.94	+21	4772.15
	from	43.4380	4772.54	+44	4772.98	...	....	....	....	....	....	72.96	+21	4773.2
B	....	....	....	....	....	...	nn B	45.8163	4775.25	+37	4775.62	75.61	+21	4775.85
	to	43.3330	4777.73	+44	4778.17	...	....	....	....	....	....	78.15	+21	4778.4
...	nn D	43.2117	4783.77	+44	4784.21	...	nn D	45.6463	4783.64	+36	4784.00	84.11	+21	4784.32
...	nn D	43.1119	4788.77	+44	4789.21	1	n D	45.5444	4788.71	+35	4789.06	89.14	+21	4789.35
	from	43.0870	4790.01	+44	4790.45		from	45.5250	4789.66	+35	4790.01	90.23	+21	4790.4
B	....	....	....	....	....	B	Max	45.4380	4794.03	+34	4794.37	94.39	+21	4794.60
	to	42.9740	4795.71	+44	4796.15		to	45.4090	4795.48	+34	4795.82	95.99	+21	4796.2
...	wn D	42.7862	4805.27	+44	4805.71	...	wn D	45.2170	4805.19	+32	4805.51	05.61	+21	4805.82
2	n B	42.7027	4809.56	+45	4810.01	...	....	....	....	....	....	09.99	+21	4810.20
...	....	....	....	....	....	1	n D	45.0995	4811.18	+31	4811.49	11.51	+21	4811.72
2	n B	42.6404	4813.28	+45	4813.73	...	....	....	....	....	....	13.71	+21	4813.92
2-3	n D	42.5982	4814.94	+45	4815.39	1-2	n D	45.0229	4815.11	+30	4815.41	15.40	+21	4815.61
B	from	42.5740	4816.19	+45	4816.64	B	from	45.0000	4816.27	+29	4816.56	16.60	+21	4816.8
	to	42.4740	4821.38	+44	4821.82		to	44.8960	4821.64	+28	4821.92	21.87	+21	4822.1
...	....	....	....	....	....	1	n D	44.8744	4822.76	+28	4823.04	23.06	+21	4823.27
...	....	....	....	....	....	2	n B	44.8280	4825.18	+28	4825.46	25.48	+21	4825.69
1	nn D	42.3615	4827.26	+44	4827.70	2	n D	44.7862	4827.35	+27	4827.62	27.67	+21	4827.88
...	....	....	....	....	....	2-3	n B	44.7425	4829.63	+26	4829.89	29.91	+21	4830.12
1-2	nn D	42.2722	4831.96	+44	4832.40	1	n D	44.6994	4831.88	+25	4832.13	32.27	+21	4832.48
...	nn D	41.9100	4851.24	+44	4851.68	...	....	....	....	....	....	51.66	+21	4851.87
	from	41.8320	4854.90	+44	4855.34		from	44.2640	4854.96	+19	4855.15	55.25	+21	4855.5
B	....	....	....	....	....	B	Max	44.1507	4861.07	+16	4861.23	61.25	+21	4861.46
	to	41.6410	4865.81	+43	4866.24		to	44.0830	4864.73	+15	4864.88	65.6	+21	4865.8
1	n D	41.6222	4866.85	+43	4867.28	1-2	n D	44.0414	4867.01	+15	4867.16	67.22	+21	4867.43
0-1	nn D	41.3720	4880.63	+42	4881.15	1	n D	43.7907	4880.75	+11	4880.86	80.88	+21	4881.09
...	....	....	....	....	....	1-2	n D	43.6319	4889.56	+ 9	4889.65	89.67	+21	4889.88
B	from	41.1520	4892.92	+41	4893.33	B	from	43.5760	4892.67	+ 8	4892.75	93.03	+21	4893.2
	to	41.0190	4900.44	+41	4900.85		to	43.4160	4901.66	+ 7	4901.73	01.27	+21	4901.5
2	D	41.0042	4901.28	+40	4901.68	...	....	....	....	....	....	01.66	+21	4901.87
1-2	n B	40.9810	4902.59	+40	4902.99	...	....	....	....	....	....	02.97	+21	4903.18
1	nn D	40.8482	4910.17	+40	4910.57	2	n D	43.2725	4909.82	+ 6	4909.88	10.28	+21	4910.49
1	nn D	40.6661	4920.66	+38	4921.04	...	....	....	....	....	....	21.02	+21	4921.23
1	n D	40.6026	4924.34	+38	4924.72	...	....	....	....	....	....	24.70	+21	4924.91
...	....	....	....	....	....	...	wn D	42.0619	4981.44	− 3	4981.41	81.43	+22	4981.65

115 *SCHJELLERUP*

Plate G 365 — 1899, December 27, G.M.T. 21^h8. Hour angle, W 1^h8. Star good; comparison fair						Plate G 374 — 1900, January 7, G.M.T. 20^h5. Hour angle, W 2^h3. Star good; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
2	n D	45.7520	5166.77	+22	5166.99	...	....	....	....	....	....	67.01	+23	5167.21
	from	45.7270	5167.78	+22	5168.00	...	....	....	....	....	....	68.02	+23	5168.3
B	...	....	....	....	....	...	nn B	46.5141	5170.54	+20	5170.74	70.73	+23	5170.96
	to	45.6140	5172.35	+21	5172.56	...	....	....	....	....	....	72.58	+23	5172.8
4	n D	45.5914	5173.29	+21	5173.50	...	nn D	46.4433	5173.42	+19	5173.61	73.56	+23	5173.79
B	from	45.5610	5174.50	+21	5174.71	...	....	....	....	....	....	74.73	+23	5175.0
	to	45.3600	5182.69	+19	5182.88	...	....	....	....	....	....	82.90	+23	5183.2
2-3	n D	45.3395	5183.55	+19	5183.74	...	nn D	46.2114	5182.84	+17	5183.01	83.38	+23	5183.61
B	from	45.3130	5184.61	+19	5184.80	...	....	....	....	....	....	84.82	+23	5185.1
	to	45.2240	5188.27	+18	5188.45	...	....	....	....	....	....	88.47	+23	5188.8
1	n D	45.2068	5189.00	+18	5189.18	...	....	....	....	....	....	89.20	+23	5189.43

115 *SCHJELLERUP—Continued*

Plate G 365						Plate G 374						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
2	n B	45.1734	5190.37	+18	5190.55	...	....	....	....	....	....	90.57	+23	5190.80
...	wn D	45.1025	5193.30	+18	5193.48	...	nn D	45.9565	5193.30	+14	5193.44	93.46	+23	5193.69
B	from	45.0520	5195.36	+17	5195.53	...	....	....	....	....	....	95.55	+23	5195.8
	to	44.8320	5204.51	+16	5204.67	...	....	....	....	....	....	04.69	+23	5204.9
D	....	....	....	....	....	...	nn D	45.5330	5210.91	+10	5211.01	11.00	+23	5211.23
	to	44.6390	5212.60	+15	5212.75	...	....	....	....	....	....	12.77	+23	5213.0
4	n B	44.6065	5213.99	+15	5214.14	3	n B	45.4592	5214.00	+10	5214.10	14.12	+23	5214.35
...	nn D	44.5520	5216.26	+14	5216.40	...	nn D	45.4030	5216.37	+10	5216.47	16.44	+23	5216.67
B	from	44.5200	5217.62	+14	5217.76	...	....	....	....	....	....	17.78	+23	5218.0
	to	44.3550	5224.61	+14	5224.75	...	....	....	....	....	....	24.77	+23	5225.0
8	nn D	44.3124	5226.44	+14	5226.58	2	n D	45.1650	5226.44	+ 8	5226.52	26.55	+23	5226 78
	from	44.2700	5228.23	+14	5228.37	...	....	....	....	....	....	28.39	+23	5228.6
B	....	....	....	....	....	...	nn B	45.0709	5230.44	+ 7	5230.51	30.50	+23	5230.73
	to	44.1760	5232.25	+14	5232.39	...	....	....	....	....	....	32.41	+23	5232.6
3	nn D	44.1515	5233.33	+14	5233.47	2-3	n D	44.9883	5233.97	+ 7	5234.04	33.76	+23	5233.99
6	wn B	44.0825	5236.29	+14	5236.43	...	n B	44.9305	5236.45	+ 6	5236.51	36.47	+23	5236.70
...	....	....	....	....	....	...	nn D	44.8554	5239.68	+ 6	5239.74	39.73	+23	5239.96
3	wn B	43.8963	5244.32	+13	5244.45	...	....	....	....	....	....	44.47	+23	5244.70
3	nn D	43.8389	5246.81	+13	5246.94	...	....	....	....	....	....	46.96	+23	5247.19
...	nn D	43.7377	5251.22	+13	5251.35	...	nn D	44.5752	5251.80	+ 5	5251.85	51.60	+23	5251.83
5	n D	43.3054	5270.22	+13	5270.35	...	nn D	44.1457	5270.64	+ 4	5270.68	70.52	+23	5270.75
...	nn B	43.0890	5279.87	+14	5280.01	...	nn B	43.9420	5279 69	+ 4	5279.73	79.87	+23	5280.10
2-3	D	42.6942	5297.67	+16	5297.83	2	n D	43.5260	5298.39	+ 5	5298.44	98.14	+23	5298.37
...	nn B	42.5400	5304.71	+17	5304.88	...	nn B	43.3840	5304.85	+ 6	5304.91	'04.90	+23	5305.13
4	n B	42.3692	5312.55	+18	5312.73	3	n B	43.2060	5313.00	+ 6	5313.06	12.90	+23	5313.13
2-3	nn D	42.3214	5314.75	+19	5314.94	3	n D	43 1597	5315.13	+ 6	5315.19	15.07	+23	5315.30
9	n B	42.2672	5317.26	+19	5317.45	7	B	43.1052	5317.64	+ 7	5317.71	17.58	+23	5317.81
1	nn D	42.2055	5320.10	+20	5320.30	3	nn D	43.0415	5320.58	+ 7	5320.65	20.48	+23	5320.71
...	nn D	41.8519	5336.64	+24	5336.88	4	n D	42.6999	5336.49	+10	5336.59	36.74	+23	5336.97
5	n B	41 8054	5338.82	+25	5339.07	6	n B	42.6474	5338.95	+10	5339.05	39.06	+23	5339.29
...	n D?	41.7544	5341.23	+27	5341.50	3	n D	42.5935	5341.49	+11	5341.60	41.55	+23	5311.78
...	nn B	41.6914	5344.21	+28	5344.49	...	nn B	42.5327	5344.35	+11	5344.46	44.48	+23	5344.71
4	n B	41.5324	5351.77	+30	5352.07	1-2	n B	42.3685	5352.13	+12	5352.25	52.16	+23	5352.39
...	....	....	....	....	....	B	from	42.3060	5355.11	+13	5355.24	55.22	+23	5355.5
...	....	....	....	....	....		to	42.1100	5364.49	+15	5364.64	64.62	+23	5364.9
...	....	....	....	....	....	1-2	n D	42.0863	5365.62	+15	5365.77	65.76	+23	5365.99
1	n D	41.2200	5366.77	+36	5367.13	...	....	....	....	....	....	67.15	+23	5367.38
3	n B	41.1918	5368.14	+36	5368.50	2	n B	42.0308	5368.29	+16	5368.45	68.48	+23	5368.71
...	....	....	....	....	....		from	42.0000	5369.78	+16	5369.94	69.93	+23	5370.2
7	wn D	41.1324	5371.01	+38	5371.39	D	....	....	....	....	....	71.41	+23	5371.64
...	....	....	....	....	....		to	41.9240	5373.37	+17	5373.54	73.49	+23	5373.7
8	n B	41.0659	5374.24	+38	5374.62	5	B	41.8970	5374.76	+17	5374.93	74.78	+23	5375.01
3	n D	41.0155	5376.70	+38	5377.08	3	n D	41.8535	5376.87	+17	5377.04	77.06	+23	5377.29
	from	40.9910	5377.86	+39	5378.25	...	....	....	....	....	....	78.27	+23	5378.5
B	....	....	....	....	....	9	wn B	41.7834	5380.28	+18	5380.46	80.45	+23	5380.68
	to	40.9170	5381.48	+40	5381.88	...	....	....	....	....	....	81.90	+23	5382.1
	from	40.8060	5386.93	+41	5387.34	...	....	....	....	....	....	87.36	+23	5387.6
B	....	....	....	....	....	4-5	wn B	41.5280	5392.78	+21	5392.99	92.98	+23	5393.21
	to	40.6730	5393.49	+43	5393.92	...	....	....	....	....	....	93.94	+23	5394.2
...	wn D	40.6217	5396.05	+44	5396.49	3	nn D	41.4562	5396.32	+22	5396.54	96.52	+23	5396.75
B	from	40.5490	5399.64	+45	5400.09	Con.	from	41.4290	5397.67	+23	5397.90	99.0	+23	5399.±
	to	40.3990	5407.12	+46	5407.58	Spec.	to	41.2280	5407.64	+25	5407.89	07.74	+23	5408.0
...	nn D	40.3628	5408.95	+46	5409.41	3	n D	41.1914	5409.47	+25	5409.72	09.57	+23	5409.80
3	n B	40.3099	5411.61	+47	5412.08	1	n B	41.1447	5411.80	+26	5412.06	12.07	+23	5412.30
1-2	n D	40.2805	5413.08	+47	5413.55	...	....	....	....	....	....	13.57	+23	5413.80
7-8	wn B	40.2187	5416.20	+48	5416.68	5	n B	41.0490	5416.59	+26	5416.85	16.77	+23	5417.00
...	....	....	....	....	....	3	nn D	40.9813	5420.00	+27	5420.27	20.26	+23	5420.49
3	n B	40.0904	5422.68	+49	5423.17	3	n B	40.9282	5422.98	+28	5423.26	23.22	+23	5423.45
...	....	....	....	....	....	...	nn D	40.8849	5424.86	+28	5425.14	25.13	+23	5425.36
2-3	n B	40.0182	5426.35	+50	5426.85	3	n B	40.8452	5426.87	+28	5427.15	26.95	+23	5427.18
...	nn D	39.9620	5429.19	+51	5429.70	3	D	40.7857	5429.89	+29	5430.18	29.94	+23	5430.17
...	....	....	....	....	....	1	n B	40.7515	5431.63	+30	5431.93	31.92	+23	5432.15
B	from	39.7600	5439.53	+52	5440.05	B	from	40.5920	5439.77	+30	5440.07	40.06	+23	5440.3
	to	39.6680	5444.27	+53	5444.80		to	40.5040	5444.28	+31	5444.59	44.70	+23	5444.9
6	n D	39.6192	5446.82	+53	5447.35	7	n D	40.4520	5446.96	+31	5447.27	47.31	+23	5447.54

115 *SCHJELLERUP—Continued*

Plate G 365						Plate G 374						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
4-5	wn B	39.5588	5449.95	+53	5450.48	4	B	40.3835	5450.49	+32	5450.81	50.65	+24	5450.89
...	....	....	....	....	....	2	nn D	40.2790	5455.90	+33	5456.23	56.22	+24	5456.46
1	n B	39.4024	5458.08	+54	5458.62	...	....	....	....	....	....	58.64	+24	5458.88
...	nn D	39.3679	5459.89	+54	5460.43	1	n D	40.1933	5460.35	+33	5460.68	60.56	+24	5460.80
...	nn D	39.2209	5467.82	+54	5468.36	...	....	....	....	....	....	68.38	+24	5468.62
...	....	....	....	....	....	5	B	39.9759	5471.73	+35	5472.08	72.07	+24	5472.31
1	nn D	39 1130	5473.27	+55	5473.82	1-2	n D	39.9322	5474.03	+35	5474.38	74.10	+24	5474.34
...	nn D	39.0324	5477.56	+55	5478.11	...	....	....	....	....	....	78.13	+24	5478.37
...	nn B	38.9810	5480.30	+55	5480.85	...	nn B	39.8169	5480.12	+36	5480.48	80.67	+24	5480.91
...	nn D	38.9345	5482.78	+56	5483.34	...	....	....	....	....	....	83 36	+24	5483.60
...	....	....	....	....	....	...	nn D	39.4914	5497.31	+38	5497.69	97.68	+24	5497.92
...	....	....	....	....	....	...	nn D	39.4079	5501.96	+38	5502.34	02.33	+24	5502.57
B	from	38.5260	5404.73	+56	5505.29	B	from	39.3740	5503.79	+38	5504.17	04.73	+24	5505.0
	to	38.4400	5509.41	+55	5509.96		to	39.2600	5509.96	+38	5510.34	10.15	+24	5510.4
...	nn D	38.3990	5511.64	+55	5512.19	2	nn D	39.2344	5511.35	+38	5511.73	11.96	+24	5512.20
B	from	38.3620	5513.66	+54	5514.20	...	....	....	....	....	....	14.22	+24	5514.5
	to	38.2000	5522.56	+54	5523.10	...	....	....	....	....	....	23.12	+24	5523.4
...	....	....	....	....	....	2	n D	38.9910	5524.63	+39	5525.02	25.01	+24	5525.25
1	n D	38.0114	5533 01	+54	5533 55	...	nn D	38.8300	5533.50	+39	5533.89	33.72	+24	5533.96
8	n D	37.9073	5538 81	+53	5539.34	8	D	38.7333	5538.86	+39	5539.25	39.30	+24	5539.54
B	from	37.8695	5540.92	+53	5541.45	B	from	38.6890	5541.32	+39	5541.71	41.58	+24	5541.8
	to	37.7840	5545.68	+53	5546.21		to	38.5970	5546.45	+39	5546.84	46.53	+24	5546.8
2	n D	37.7664	5547.26	+52	5547.78	2-3	n D	38.5649	5548.23	+39	5548.62	48.21	+24	5548.45
...	....	....	....	....	....	1-2	D	38.4944	5552.19	+38	5552.57	52.56	+24	5552.80
2	n B	37.6408	5553.77	+52	5554.29	1	n B	38.4655	5553.81	+38	5554.19	54.24	+24	5554.48
2	n D	37.6097	5555.53	+51	5556.04	1	n D	38.4297	5555.82	+38	5556.20	56.12	+24	5556.36
...	....	....	....	....	....	1	n D	38.3238	5561.79	+38	5562.17	62.16	+24	5562.40
1-2	n B	37.4633	5563.84	+50	5564.34	...	nn B	38.2752	5564.54	+38	5564.92	64.63	+24	5564.87
...	....	....	....	....	....	...	n D	38.2353	5566.81	+38	5567.19	67.18	+24	5567.42
B	from	37.4080	5566.97	+50	5567.47	...	....	....	....	....	....	67.49	+24	5567.7
	....	....	....	....	....	Max	B	38.1680	5570.63	+38	5571.01	71.00	+24	5571.24
	to	37.3140	5572.35	+50	5572.85	...	....	....	....	....	....	72.87	+24	5573.1
...	....	....	....	....	....	1	n D	38.0620	5576.68	+38	5577.06	77.05	+24	5577.29
9	D	37.1290	5583.03	+49	5583.52	9	D	37.9469	5583.28	+37	5583.65	83.59	+24	5583.83
...	....	....	....	....	....	Limits	....	37.9810	5584.33	+37	5584.70	84.69	+24	5584.9
...	....	....	....	....	....	Limits	....	37.9120	5585.30	+37	5585.67	85.66	+24	5585.9
Head	....	37.0860	5585.49	+48	5585.97	...	....	....	....	....	....	85.97	+24	5586.21
4	B	37.0640	5586.79	+48	5587.27	6	B	37.8789	5587.20	+37	5587.57	87.42	+24	5587.66
5	B	36.9802	5591.66	+47	5592.13	8	B	37.8008	5591.71	+37	5592.08	92.11	+24	5592.35
B	to	36.9590	5592.86	+47	5593.33	...	....	....	....	....	....	93.35	+24	5593.6
...	nn D	36.9348	5594.31	+46	5594.77	...	n D	37.7512	5594.59	+36	5594.95	94.86	+24	5595.10
6	B	36.8912	5596 85	+46	5597.31	4	n B	37.7065	5597.18	+36	5597.54	97.43	+24	5597.67
...	nn D	36.8469	5599.45	+46	5599.91	1	n D	37.6714	5599.23	+36	5599.59	99.79	+24	5600.03
...	....	....	....	....	....	...	wn D	37.4997	5609.26	+34	5609.60	09.59	+24	5609.83
...	nn D	36.5070	5619.49	+42	5619.91	...	....	....	....	....	....	19.93	+24	5620.17
...	nn D	36.4155	5624.97	+41	5625.38	...	nn D	37.2422	5624.46	+33	5624.79	25.40	+24	5625.64
Con. Spec.	from	36.3890	5626.53	+41	5626.94	Con. Spec.	from	37.1990	5627.03	+32	5627.35	27.15	+24	5627.4
	to	36 3040	5631.62	+40	5632 02		to	37.1180	5631.86	+32	5632.18	32.10	+24	5632.3
10	D	36.2670	5633.88	+40	5634.28	10	D	37.0807	5634.09	+31	5634.40	34.34	+24	5634.58
Head	....	36.2194	5636.74	+40	5637.14	Head	....	37.0310	5637.06	+30	5637.36	37.25	+24	5637.49
B	to	36.1200	5642.73	+39	5643.12	B	to	36.9250	5643.44	+29	5643.73	43.43	+24	5643.7
...	....	....	....	....	....	...	nn D	36.9014	5644.68	+29	5644.97	44.96	+24	5645.20
...	....	....	....	....	....		from	36.8850	5645.85	+29	5646.14	46.13	+24	5646.4
...	n B	36 0730	5645.57	+38	5645.95	B	....	....	....	....	....	45.97	+24	5646.21
...	n B	35.9300	5654.29	+37	5654.66	2	n B	36.7283	5655.34	+27	5655.61	55.1	+25	5655.3
...	....	....	....	....	....		to	36.7140	5656.22	+27	5656.49	56.48	+25	5656.7
...	nn D	35.8754	5657.66	+37	5658.03	...	nn D	36.6963	5657.29	+27	5657.56	57.80	+25	5658.05
...	....	....	....	....	....	Con. Spec.	from	36.6730	5658.71	+27	5658.98	58.97	+25	5659.2
...	....	....	....	....	....		to	36.1910	5669.86	+25	5670.11	70.10	+25	5670.4
1-2	n D	35.6579	5671.07	+31	5671.11	...	....	....	....	....	....	71.43	+25	5671.68
2	n B	35.6220	5673.29	+34	5673.63	2	n B	36.4179	5674.35	+23	5674.58	74.06	+25	5674.31
...	....	....	....	....	....	1	n D	36.3878	5676.20	+23	5676.43	76.42	+25	5676.67
2	n B	35.5207	5679.59	+33	5679.92	2	n B	36.3384	5679.27	+22	5679.49	79.71	+25	5679.96
1-2	n B	35.4630	5683.20	+31	5683.51	2	n B	36 2590	5684.19	+21	5684.40	83.96	+25	5684.21
...	....	....	....	....	....	1	n D	36 2249	5686.31	+21	5686.52	86.51	+25	5686.76

115 *SCHJELLERUP — Continued*

Plate G 365						Plate G 374						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
8	n B	35.2982	5693.54	+30	5693.84	7	n B	36.1055	5693.77	+20	5693.97	93.91	+25	5694.16
1	n D	35.2494	5696.61	+30	5696.91	...	....	....	....	....	....	96.93	+25	5697.18
2	n B	35.2134	5698.89	+29	5699.18	1	n B	36.0236	5698.90	+19	5699.09	99.14	+25	5699.39
4	n B	35.1234	5704.59	+28	5704.87	6	n B	35.9313	5704.72	+18	5704.90	04.89	+25	5705.14
...	....	....	....	....	....	1	n D	35.8845	5707.67	+18	5707.85	07.84	+25	5708.09
2	n B	35.0267	5710.76	+27	5711.03	...	....	....	....	....	....	11.05	+25	5711.30
7	n B	34.9352	5716.61	+26	5716.87	8	n B	35.7407	5716.80	+16	5716.96	16.92	+25	5717.17
5	n B	34.8120	5724.54	+25	5724.79	8	n B	35.6236	5724.28	+14	5724.42	24.61	+25	5724.86
1-2	n D	34.7040	5731.52	+24	5731.76	2	n D	35.5107	5731.53	+14	5731.67	31.72	+25	5731.97
B	from	34.6770	5733.24	+24	5733.48	B	from	35.4920	5732.74	+13	5732.87	33.18	+25	5733.5
	to	34.5390	5742.23	+23	5742.46		to	35.3500	5741.93	+12	5742.05	42.26	+25	5742.6
...	....	....	....	....	....	1	n D	35.3277	5743.37	+12	5743.49	43.48	+25	5743.73
...	....	....	....	....	....	1	n D	35.2492	5748.48	+11	5748.59	48.58	+25	5748.83
B	from	34.3820	5752.53	+21	5752.74	...	....	....	....	....	....	52.76	+25	5753.0
	Max	34.3133	5757.10	+21	5757.31	Max	B	35.1160	5757.19	+10	5757.29	57.30	+25	5757.55
	to	34.2550	5760.92	+20	5761.12	...	....	....	....	....	....	61.14	+25	5761.4
...	....	....	....	....	....	1	n D	35.0335	5762.62	+ 9	5762.71	62.70	+25	5762.95
3	n B	34.1602	5767.26	+19	5767.45	...	nn B	34.9640	5767.21	+ 9	5767.30	67.38	+25	5767.63
...	wn D	34.1017	5771.16	+19	5771.35	...	wn D	34.9088	5770.85	+ 8	5770.93	71.14	+25	5771.39
1-2	n B	34.0310	5775.89	+18	5776.07	1	n B	34.8289	5776.17	+ 8	5776.25	76.16	+25	5776.41
2	n B	33.9660	5780.25	+18	5780.43	1-2	n B	34.7605	5780.72	+ 8	5780.80	80.62	+25	5780.87
...	nn D	33.8890	5785.40	+18	5785.58	...	wn D	34.7040	5784.50	+ 7	5784.57	84.58	+25	5784.83
...	nn D	33.4122	5818.00	+16	5818.16	...	....	....	....	....	....	18.18	+25	5818.43
...	....	....	....	....	....	...	nn D	34.1332	5823.26	+ 6	5823.32	23.31	+25	5823.56
...	nn D	33.3192	5824.45	+16	5824.61	...	....	....	....	....	....	24.63	+25	5824.88
...	nn D	33.2180	5831.46	+16	5831.62	...	....	....	....	....	....	31.64	+25	5831.89
...	....	....	....	....	....	...	nn D	33.7510	5849.83	+ 6	5849.89	49.88	+25	5850.13
...	....	....	....	....	....	...	nn D	33.7283	5851.42	+ 6	5851.48	51.47	+25	5851.72
1-2	n D	32.8919	5854.44	+16	5854.60	...	....	....	....	....	....	54.62	+25	5854.87
...	nn D	32.3880	5890.63	+16	5890.79	...	....	....	....	....	....	90.81	+25	5891.06
...	nn D	32.3010	5897.01	+16	5897.17	...	....	....	....	....	....	97.19	+25	5897.44

152 *SCHJELLERUP*

PLATE G 316 1899, March 31, G.M.T. 20h7. Hour angle, W 2h7 Star good; comparison good						PLATE G 394 1900, April 4, G.M.T. 17h3. Hour angle, W 2h7 Star excellent; comparison good					
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length
		mm.	t.m.		t.m.			mm.	t.m.		t.m.
Spec. begins		58.9690	4396.20	−10	4396.10	Begins	....	61.7570	4397.10	−17	4396.93
2-3	B	58.6310	4402.40	−12	4402.28	2	n B	61.4442	4402.89	−18	4402.71
3	n D	58.4912	4405.05	−13	4404.92	...	....	....	....	....	....
D }	from	58.5770	4403.40	−12	4403.28	D }	from	61.4100	4403.60	−18	4403.42
	to	58.2540	4409.50	−15	4409.35		to	61.0700	4410.10	−20	4409.90
1	n D	58.1867	4410.75	−16	4410.59	...	....	....	....	....	....
1	n D	58.0933	4412.51	−17	4412.34	1	n D	60.9170	4412.93	−20	4412.73
4	n D	57.9313	4415.57	−18	4415.39	3	nn D	60.7711	4415.73	−21	4415.52
1	B	57.6350	4421.02	−20	4420.82	...	....	....	....	....	....
2	B	57.4832	4424.10	−21	4423.89	...	....	....	....	....	....
2	n D	57.3827	4426.03	−22	4425.81	...	....	....	....	....	....
2	n D	57.2937	4427.75	−23	4427.52	2	n D	60.1277	4428.24	−25	4427.99
1-2	nn D	57.1416	4430.69	−24	4430.45	3-4	n D	60.0007	4430.72	−25	4430.47
6	w D	56.8532	4436.28	−26	4436.02	...	wn D	59.7280	4436.20	−27	4435.93
1	n D	56.7420	4438.46	−28	4438.18	...	....	....	....	....	....
1	nn D	56.4200	4444.80	−30	4444.50	1	n D	59.2771	4445.09	−29	4444.80
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
2-3	n D	56.2754	4447.64	−31	4447.33	1	n D	59.1274	4448.11	−29	4447.82
...	wn D	56.1260	4450.60	−32	4450.28	...	....	....	....	....	....
...	....	....	....	....	....	1	n D	58.7524	4455.71	−31	4455.40
...	....	....	....	....	....	1	n D	58.6200	4458.41	−31	4458.10
1	B	55.7027	4459.09	−35	4458.74	...	....	....	....	....	....
...	wn D	55.6427	4460.30	−36	4459.94	...	....	....	....	....	....
4-5	n D	55.5430	4462.30	−36	4461.91	...	wn D	58.4201	4462.51	−32	4462.19
...	....	....	....	....	....	...	....	....	....	....	....
5	B	55.4503	4464.19	−37	4463.82	8	B	58.3192	4464.58	−32	4464.26
Con.	from	55.4130	4464.95	−37	4464.58	...	....	....	....	....	....
...	....	....	....	....	....	1	n D	58.1140	4468.83	−33	4468.50
...	....	....	....	....	....	1	n D	57.9535	4472.16	−33	4471.83
...	....	....	....	....	....	...	....	....	....	....	....
Spec.	to	55.0190	4473.00	−38	4472.62	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	wn B	54.9770	4473.90	−38	4473.52	...	....	....	....	....	....
...	wn B	54.7200	4479.20	−40	4478.80	...	....	....	....	....	....
2	n D	54.6613	4480.38	−40	4479.98	...	....	....	....	....	....
2	n D	54.5512	4482.67	−41	4482.26	1	n D	57.4410	4482.95	−35	4482.60
Unresolv'd	from	54.5220	4483.28	−41	4482.87	...	....	....	....	....	....
...	....	....	....	....	....	1	n D	57.3413	4485.03	−35	4484.68
...	....	....	....	....	....	1	nn D	57.2196	4487.62	−35	4487.27
	to	54.2850	4488.20	−42	4487.78	...	....	....	....	....	....
1	B	54.2598	4488.76	−42	4488.34	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
3-4	D	54.1951	4490.12	−42	4489.70	2	D	57.1107	4489.94	−36	4489.58
Unresolv'd	from	54.1600	4490.86	−42	4490.44	...	....	....	....	....	....
	to	53.5890	4502.98	−44	4502.54	1	n D	56.5255	4502.54	−37	4502.17
...	....	....	....	....	....	2-3	nn B	56.4500	4504.18	−37	4503.81
1	n D	53.1888	4505.13	−44	4504.69	1	n D	56.3958	4505.36	−37	4504.99
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	2-3	nn B	56.3151	4506.46	−37	4506.09
2-3	nn D	53.3715	4507.58	−44	4507.14	1	nn D	56.2874	4507.73	−37	4507.36
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	1	nn D	56.0377	4513.21	−38	4512.83
1	nn D	52.9640	4516.48	−44	4516.01	...	....	....	....	....	....
1	B	52.9100	4517.66	−44	4517.22	...	....	....	....	....	....
1-2	wn D	52.8577	4518.80	−44	4518.36	...	....	....	....	....	....
1	nn D	52.7749	4520.62	−44	4520.18	...	....	....	....	....	....
6	n D	52.6402	4523.58	−44	4523.14	4	n D	55.5652	4523.69	−38	4523.31
1	B	52.5804	4524.89	−44	4524.45	6	B	55.4965	4525.16	−38	4524.78
1-2	nn D	5205.12	4536.66	−43	4536.23	...	....	....	....	....	....

152 *SCHJELLERUP*

Plate A 313 1902, February 10, G.M.T. 18h3. Hour angle, E 2h8 Star good; comparison good						Plate A 319 1902, February 18, G.M.T. 17h7. Hour angle, E 3h0 Star excellent; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	...	...	...	...	...	...	...	...	...	...	...	96.52	− 1	4396.5
...	...	...	...	...	...	...	...	...	...	...	...	02.71	− 1	4402.70
...	...	...	...	...	...	...	...	...	...	...	...	04.92	− 1	4404.91
...	...	...	...	...	...	...	...	...	...	...	...	03.35	− 1	4403.3
...	...	...	...	...	...	...	...	...	...	...	...	09.63	− 1	4409.6
...	...	...	...	...	...	...	...	...	...	...	...	10.59	− 1	4410.58
...	...	...	...	...	...	2	D	35.2114	4413.02	−70	4112.32	12.46	− 1	4412.45
...	...	...	...	...	...	...	...	...	...	...	...	15.46	− 1	4415.45
...	...	...	...	...	...	...	...	...	...	...	...	20.82	− 1	4420.81
...	...	...	...	...	...	...	...	...	...	...	...	23.89	− 1	4123.88
...	...	...	...	...	...	...	...	...	...	...	...	25.81	− 1	4425.80
...	...	...	...	...	...	...	nn D	36.4720	4428.40	−67	4427.73	27.75	− 1	4427.74
...	...	...	...	...	...	...	nn D	36.7110	4431.39	−66	4430.73	30.55	− 1	4430.54
...	...	...	...	...	...	...	...	...	...	...	...	35 98	− 1	4435.97
...	...	...	...	...	...	2	n D	37.3194	4438.98	−65	4438.33	38.26	− 1	4438.25
...	nn D	39.7434	4444.63	+ 9	4444.72	...	wn D	37.8153	4445.23	−64	4444.59	44.65	− 1	4444.64
...	...	...	...	...	...	2	B	37.8728	4445.96	−63	4445.33	45.33	− 1	4445.32
...	...	...	...	...	...	2	D	37.9097	4446.43	−63	4445.80	45.80	− 1	4445.79
...	...	...	...	...	...	1	n B	37.9552	4447.01	−63	4446.38	46.38	− 1	4446.37
...	...	...	...	...	...	...	...	...	...	...	...	47.58	− 1	4447.57
...	...	...	...	...	...	...	...	...	...	...	...	50.28	− 2	4450.3
...	...	...	...	...	...	...	...	...	...	...	...	55.40	− 2	4455.38
...	...	...	...	...	...	...	...	...	...	...	...	58.10	− 2	4458.08
...	...	...	...	...	...	...	...	...	...	...	...	58.74	− 2	4458.72
...	...	...	...	...	...	...	...	...	...	...	...	59.94	− 2	4459.92
...	...	...	...	...	...	...	...	...	...	...	...	62.07	− 2	4462.05
...	...	...	...	...	...	1	n D	39.2880	4464.14	−58	4463.56	63.56	− 2	4463.54
2	n B	41.2680	4464.30	+ 5	4464.35	2	n B	39.3297	4464.68	−58	4464.10	61.11	− 2	4464.09
...	n D	41.3094	4464.85	+ 5	4464.90	...	...	...	...	...	...	64.58	− 2	4464.6
...	...	...	...	...	...	...	...	...	...	...	...	61.90	− 2	4464.88
...	...	...	...	...	...	...	...	...	...	...	...	68.50	− 2	4468.48
...	...	...	...	...	...	...	...	...	...	...	...	71.83	− 2	4471.81
...	...	...	...	...	...	...	...	...	...	...	...	72.62	− 2	4472.6
...	...	...	...	...	...	1	n B	39.9765	4473.14	−55	4472.59	72.59	− 2	4472.57
...	...	...	...	...	...	2	D	40.0205	4473.72	−55	4473.17	73.17	− 2	4473.15
...	...	...	...	...	...	3	n B	40.0547	4474.18	−55	4473.63	73.58	− 2	4473.56
...	...	...	...	...	...	...	...	...	...	...	...	78.80	− 2	4478.78
...	...	...	...	...	...	...	...	...	...	...	...	79.98	− 2	4479.96
...	...	...	...	...	...	2	n D	40.7209	4483.02	−52	4482.50	82.45	− 2	4482.43
...	...	...	...	...	...	...	...	...	...	...	...	82.87	− 2	4482.9
...	...	...	...	...	...	1	n D	40.9565	4486.17	−51	4485.66	85.17	− 2	4485.15
...	...	...	...	...	...	...	nn D	41.0800	4487.83	−50	4487.33	87.30	− 2	4487.28
...	...	...	...	...	...	...	...	...	...	...	...	87.78	− 2	4487.8
...	...	...	...	...	...	1	n B	41.1350	4488.57	−50	4488.07	88.21	− 2	4488.19
...	...	...	...	...	...	1-2	D	41.1630	4488.95	−50	4188.45	88.45	− 2	4488.43
...	...	...	...	...	...	1	n B	41.1932	4489.35	−49	4488.86	88.86	− 2	4488.84
...	...	...	...	...	...	...	nn D	41.2490	4490.10	−49	4489.61	89.63	− 2	4489.61
...	...	...	...	...	...	...	...	...	...	...	...	90.44	− 2	4490.4
...	...	...	...	...	...	...	...	...	...	...	...	02.17	− 2	4502.15
...	...	...	...	...	...	...	...	...	...	...	...	03.81	− 2	4503.79
...	...	...	...	...	...	...	...	...	...	...	...	01.84	− 2	4504.82
...	...	...	...	...	...	3	n D	42.3950	4505.73	−44	4505.29	05.29	− 2	4505.27
...	...	...	...	...	...	2	n B	42.4478	4506 45	−44	4506.01	06.05	− 2	4506.03
...	...	...	...	...	...	...	nn D	42.5395	4507.72	−44	4507.28	07.26	− 2	4507.24
...	...	...	...	...	...	3	n D	42.7340	4510.41	−43	4509.98	09.98	− 2	4509.96
...	...	...	...	...	...	...	...	...	...	...	...	12.83	− 2	4512.81
...	...	...	...	...	...	...	...	...	...	...	...	16 04	− 2	4516.02
...	...	...	...	...	...	...	...	...	...	...	...	17.22	− 2	4517.20
...	...	...	...	...	...	...	n D	43.3162	4518.53	−40	4518.13	18.25	− 2	4518.23
...	...	...	...	...	...	...	...	...	...	...	...	20.18	− 2	4520.16
...	...	...	...	...	...	...	...	...	...	...	...	23.23	− 2	4523.21
1	n B	45.7022	4524.74	+ 1	4524.75	3	B	43.7754	4524.99	−37	4521.62	24.65	− 2	4524.63
...	...	...	...	...	...	...	...	...	...	...	...	36.23	− 2	4536.21

152 *SCHJELLERUP—Continued*

PLATE G 316						PLATE G 394					
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length
		mm.	t.m.		t.m.			mm.	t.m.		t.m.
...	....	....	....	....	....		from	54.9510	4537.60	−38	4537.22
4	n B	51.9974	4537.86	−42	4537.44		....	....	....	....	....
...	....	....	....	....	....	B	....	....	....	....	....
4	n B	51.9255	4539.48	−42	4539.06		....	....	....	....	....
...	....	....	....	....	....		to	54.8170	4540.60	−38	4540.22
1	n D	51.8711	4540.70	−42	4540.28	1	n D	54.7986	4541.02	−38	4540.64
...	....	....	....	....	....	...	....	....	....	....	....
...	wn D	51.6280	4543.94	−41	4543.53	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	w D	54.5651	4546.37	−38	4545.99
5	n B	51.5481	4548.02	−41	4547.61	3	n B	54.4856	4548.20	−38	4547.82
5	n D	51.4797	4549.57	−41	4549.16	6	w D	54.4166	4549.80	−38	4549.42
...	....	....	....	....	....	...	wn D	54.2770	4553.04	−37	4552.67
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
2	n D	50.9920	4560.77	−38	4560.39	...	D	53.9320	4561.08	−37	4560.71
...	....	....	....	....	....	...	....	....	....	....	....
1	n D	50.8720	4563.55	−38	4563.17	3	n D	53.8097	4563.96	−37	4563.59
2	n B	50.8120	4564.94	−38	4564.56	...	....	....	....	....	....
1	n D	50.7657	4566.02	−37	4565.65	2	n D	53.7012	4566.52	−36	4566.16
2	n B	50.6820	4567.98	−37	4567.61	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....		from	53.4990	4571.32	−36	4570.96
...	....	....	....	....	....	D	....	....	....	....	....
...	....	....	....	....	....		to	53.1870	4578.77	−35	4578.42
...	....	....	....	....	....	...	....	....	....	....	....
2	n B	50.1998	4579.32	−34	4578.98	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
1	nn D	50.1380	4580.79	−34	4580.45	2	n D	53.1010	4580.84	−35	4580.49
1-2	nn B	50.0925	4581.87	−34	4581.53	...	....	....	....	....	....
...	....	....	....	....	....	1	n D	52.9990	4583.30	−34	4582.96
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
1	nn D	49.8175	4588.43	−33	4588.10	...	....	....	....	....	....
...	....	....	....	....	....		....	....	....	....	....
...	....	....	....	....	....		from	52.7520	4589.28	−33	4588.95
...	....	....	....	....	....		....	....	....	....	....
...	....	....	....	....	....	B	....	....	....	....	....
...	....	....	....	....	....		....	....	....	....	....
...	....	....	....	....	....		....	....	....	....	....
...	....	....	....	....	....		to	52.5790	4593.50	−33	4593.17
2	n D	49.5760	4594.25	−31	4593.94	1	n D	52.5471	4594.28	−33	4593.95
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	Max	B	52.4862	4595.77	−33	4595.44
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
2	nn D	49.4120	4597.50	−31	4597.19	...	....	....	....	....	....
Max	B	49.3580	4599.54	−30	4599.24	...	....	....	....	....	....
...	....	....	....	....	....	1	n D	52.2643	4601.23	−32	4600.91
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
Max	B	48.8170	4612.81	−28	4612.53	...	....	....	....	....	....
1-2	D	48.7710	4613.94	−27	4613.67	1	n D	51.7387	4614.32	−29	4614.03
2	n B	48.7141	4615.43	−27	4615.16	...	....	....	....	....	....
2	n D	48.6600	4616.70	−26	4616.44	4	n D	51.6393	4616.82	−29	4616.53
8	B	48.5962	4618.29	−26	4618.03	7	B	51.5719	4618.52	−28	4618.24
4	D	48.5380	4619.74	−26	4619.48	2	D	51.5169	4619.90	−28	4619.62
1-2	n D	48.4222	4622.63	−25	4622.38	1	n D	51.4000	4622.88	−28	4622.60
...	....	....	....	....	....	1	n D	51.2770	4626.00	−27	4625.73
...	....	....	....	....	....	...	....	....	....	....	....
1	n D	47.8027	4638.30	−24	4638.09	...	....	....	....	....	....

152 *SCHJELLERUP—Continued*

Plate A 313						Plate A 319						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	....	....	....	....	....	...	....	....	....	....	....	....	− 2	4537.2
1	n B	46.6190	4537.87	+ 1	4537.88	2–3	n B	44.6949	4538.11	−32	4537.79	37.70	− 2	4537.68
2	n D	46.6693	4538.60	+ 2	4538.62	5	D	44.7372	4538.72	−32	4538.40	38.51	− 2	4538.49
1	n B	46.7195	4539.32	+ 2	4539.34	8	B	44.7878	4539.45	−31	4539.14	39.18	− 2	4539.16
...	....	....	....	....	....	...	....	....	....	....	....	40.22	− 2	4540.2
...	....	....	....	....	....	...	nn D	44.8790	4540.77	−31	4540.46	40.46	− 2	4540.44
...	....	....	....	....	....	2–3	n D	45.0277	4542.92	−30	4542.62	43.08	− 2	4543.06
...	....	....	....	....	....	...	....	....	....	....	....	43.53	− 2	4543.51
...	....	....	....	....	....	1	n B	45.1307	4544.41	−29	4544.12	44.12	− 2	4544.10
...	....	....	....	....	....	1	D	45.1970	4545.38	−29	4545.09	45.54	− 2	4545.5
2	n B	47.3029	4547.82	+ 2	4547.84	6	B	45.3773	4548.00	−28	4547.72	47.75	− 2	4547.73
...	....	....	....	....	....	...	....	....	....	....	....	49.29	− 2	4549.27
...	....	....	....	....	....	...	....	....	....	....	....	52.67	− 2	4552.65
1	n B	47.8705	4556.17	+ 3	4556.20	1	n B	45.9431	4556.30	−25	4556.05	56.05	− 2	4556.03
...	....	....	....	....	....	1	n B	46.1360	4559.10	−23	4558.87	58.87	− 2	4558.85
...	....	....	....	....	....	...	nn D	46.1780	4559.80	−22	4559.58	60.23	− 2	4560.21
...	....	....	....	....	....	1	n B	46.3627	4562.51	−22	4562.29	62.29	− 2	4562.27
...	....	....	....	....	....	1	D	46.4690	4564.20	−21	4563.99	63.58	− 2	4563.56
2	n B	48.4499	4564.80	+ 5	4564.85	3–4	n B	46.5230	4564.90	−21	4564.69	64.70	− 2	4564.68
...	....	....	....	....	....	5	D	46.5964	4565.99	−20	4565.79	65.87	− 2	4565.85
1	n D	48.6107	4567.21	+ 5	4567.26	2	D	46.6857	4567.33	−20	4567.13	67.20	− 2	4567.18
2	n B	48.6497	4567.80	+ 5	4567.85	3	B	46.7274	4567.95	−20	4567.75	67.74	− 2	4567.72
1	n B	48.8192	4570.34	+ 5	4570.39	3	B	46.8945	4570.45	−19	4570.26	70.33	− 2	4570.31
...	....	....	....	....	....	...	....	....	....	....	....	70.96	− 2	4570.9
...	....	....	....	....	....	2	D	47.3845	4577.85	−16	4577.69	77.69	− 2	4577.67
...	....	....	....	....	....	...	....	....	....	....	....	78.42	− 2	4578.4
...	....	....	....	....	....	1–2	B	47.4429	4578.74	−16	4578.58	78.78	− 2	4578.76
1	n D	49.4009	4579.16	+ 7	4579.23	2	D	47.4832	4579.35	−16	4579.19	79.21	− 2	4579.19
...	....	....	....	....	....	1–2	B	47.5162	4579.85	−16	4579.69	79.69	− 2	4579.67
2	n D	49.4940	4580.59	+ 7	4580.66	4	D	47.5667	4580.62	−15	4580.47	80.52	− 2	4580.50
...	....	....	....	....	....	2	B	47.6152	4581.36	−15	4581.21	81.37	− 2	4581.35
...	....	....	....	....	....	1	B	47.7889	4584.01	−13	4583.88	82.96	− 2	4582.94
...	....	....	....	....	....	...	....	....	....	....	....	83.88	− 2	4583.86
...	....	....	....	....	....	...	n D	47.8447	4584.86	−12	4584.74	84.74	− 2	4584.72
...	....	....	....	....	....	2	D	47.9517	4586.50	−11	4586.39	86.39	− 2	4586.37
...	....	....	....	....	....	...	....	....	....	....	....	88.95	− 2	4588.9
...	....	....	....	....	....	2	B	48.1270	4589.19	−10	4589.09	89.09	− 2	4589.07
...	nn D	50.0940	4589.81	+ 8	4589.89	3	D	48.1742	4589.92	−10	4589.82	89.86	− 2	4589.84
...	....	....	....	....	....	1	n B	48.2210	4590.65	− 9	4590.56	90.56	− 2	4590.54
2	nn D	50.1904	4591.30	+ 9	4591.39	2	D	48.2588	4591.23	− 8	4591.15	91.27	− 2	4591.25
1–2	n B	50.2325	4591.95	+ 9	4592.04	3	B	48.3040	4591.93	− 8	4591.85	91.95	− 2	4591.93
...	....	....	....	....	....	...	....	....	....	....	....	93.17	− 2	4593.2
...	....	....	....	....	....	4–5	D	48.4403	4594.03	− 8	4593.95	93.95	− 2	4593.93
...	....	....	....	....	....		from	48.4810	4594.70	− 7	4594.63	94.63	− 2	4594.6
...	....	....	....	....	....	B	....	....	....	....	....	95.44	− 2	4595.42
...	....	....	....	....	....		to	48.5650	4596.00	− 7	4595.93	95.93	− 2	4595.9
...	....	....	....	....	....	4	n D	48.6163	4596.77	− 6	4596.71	96.71	− 2	4596.69
...	....	....	....	....	....	1	D	48.6999	4597.64	− 6	4597.58	97.39	− 2	4597.37
...	....	....	....	....	....	...	....	....	....	....	....	99.24	− 2	4599.22
...	....	....	....	....	....	...	....	....	....	....	....	00.91	− 2	4600.89
...	....	....	....	....	....	1	n B	48.9722	4602.32	− 3	4602.29	02.29	− 2	4602.27
...	....	....	....	....	....	...	nn D	49.0083	4602.88	− 3	4602.85	02.85	− 2	4602.83
...	....	....	....	....	....	...	wn D	49.2316	4606.39	0	4606.39	06.39	− 2	4606.37
...	....	....	....	....	....	...	n D	49.3930	4608.93	+ 1	4608.94	08.94	− 2	4608.92
...	....	....	....	....	....	2	D	49.5517	4611.44	+ 2	4611.46	11.46	− 2	4611.44
...	....	....	....	....	....	2	B	49.5840	4611.95	+ 2	4611.97	12.25	− 2	4612.23
...	....	....	....	....	....	3	D	49.7190	4614.10	+ 4	4614.14	13.95	− 2	4613.93
...	....	....	....	....	....	...	....	....	....	....	....	15.16	− 2	4615.14
4	B	51.8908	4618.08	+16	4618.24	8	w D	49.8564	4616.28	+ 4	4616.32	16.44	− 2	4616.42
3–4	D	51.9615	4619.23	+16	4619.39	5	B	49.9700	4618.10	+ 5	4618.15	18.17	− 2	4618.15
...	....	....	....	....	....	4–5	n D	50.0348	4619.13	+ 5	4619.18	19.42	− 2	4619.40
...	....	....	....	....	....	...	....	....	....	....	....	22.49	− 2	4622.47
...	....	....	....	....	....	...	....	....	....	....	....	25.73	− 2	4625.71
1	n B	52.5785	4629.18	+18	4629.36	...	....	....	....	....	....	29.36	− 2	4629.34
...	....	....	....	....	....	...	....	....	....	....	....	38.09	− 2	4638.07

152 *SCHJELLERUP — Continued*

Plate G 316						Plate G 394					
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length
		t.m.	t.m.		t.m.			mm.	t.m.		t.m.
...	....	....	....	....	....	...	....	....	....	....	....
4	B	47.7669	4639.22	−21	4639.01	3	B	50.7557	4639.39	−21	4639.15
5 6	D	47.7045	4640.82	−20	4640.62	4 5	D	50.6933	4641.01	−24	4640.77
...	No details in blue		band	....	....	...	....	....	....	....	....
...	w D	44.1820	4736.50	+ 8	4736.58	...	....	....	....	....	....
	from	44.1180	4738.35	+ 8	4738.43	...	....	....	....	....	....
B	....	41.0790	4739.47	+ 8	4739.55	0 1	B	47.1154	4739.50	− 2	4739.48
	to	44.0160	4741.30	+ 8	4741.38	...	....	....	....	....	....
...	....	....	....	....	....	D	from	47.0840	4740.42	− 2	4740.40
	from	43.8840	4745.12	+10	4745.22		to	46.9020	4745.76	− 1	4745.75
B		43.8340	4746.58	+10	4746.68	Max	B	46.8439	4717.46	− 1	4747.45
	to	43.7430	4749 24	+11	4719.35		to	46.7800	4749.34	0	4749.34
.	w D	43.6758	4751.19	+11	4751.30	...	w D	46.7093	4751.43	0	4751.43
...	Head	43.6242	4752.70	+11	4752.81		Head	46.6466	4753.29	0	4753.29
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	wn D	46.4490	4759.18	+ 1	4759.19
Max	B	43.3482	4760.84	+13	4760.97	2	B	46.3903	4760.93	+ 1	4760.94
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
Max	B	42.8738	4775.01	+16	4775.17	3	n B	45.9100	4775.43	+ 3	4775.46
...	....	....	....	....	....	1	n D	45.8620	4776.89	+ 3	4776.92
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	1	n D	45.7700	4779.70	+ 3	4779.73
...	....	....	....	....	....	2	n B	45.6740	4782.64	+ 3	4782.67
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
Max	B	12.3315	4791.39	+18	4791.57	2	n B	45.3800	4791.71	+ 4	4791.75
...	....	....	....	....	....	...	....	....	....	....	....
Max	B	42.2206	4795.89	+18	4796.07	3	n B	45.2600	4795.44	+ 4	4795.48
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
1–2	n D	41.5465	4815.91	+20	4816.11	2	nn D	44.5980	4816.28	+ 5	4816.33
1	B	41.3355	4822.59	+20	4822.79	...	....	....	....	....	....
1 2	nn D	41.3007	4823.69	+20	4823.89	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
4 5	B	41.2325	4825.87	+20	4826.07	4	n B	44.2948	4825.99	+ 5	4826.04
...	....	....	....	....	....	...	....	....	....	....	....
2 3	n D	41.1665	4827.97	+20	4828.17	2	n D	44.2250	4828.24	+ 5	4828.29
5	B	41.0973	4830.19	+20	4830.39	4	n B	44.1491	4830.68	+ 5	4830.73
4	n D	41 0302	4832.34	+20	4832.51	5	D	44.0887	4832.65	+ 5	4832.70
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
1–2	nn D	40.6867	4843.45	+19	4843.64	1 2	n D	43.7565	4843.49	+ 5	4843.54
1	B	40.6368	4845.07	+18	4845.25	...	....	....	....	....	....
...	..	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	...	....	....	....	....	....
1	n D	40.4305	4851.82	+17	4851.99	...	....	....	....	....	....
1	n D	10.3055	4855.93	+17	4856 10	...	....	....	....	....	....
.	....	....	....	....	....	...	....	....	....	....	....
...	....	....	....	....	....	2 3	B	43.3169	4858.03	+ 4	4858.07
.	....	....	....	....	....	...	....	....	....	....	....
1	n D	40.2020	4859.36	+16	4859.52	1	nn D	43.2659	4859.71	+ 4	4859.78
...		......:	....	....	....	...	....	....	....	...	....

152 *SCHJELLERUP—Continued*

Plate A 313						Plate A 319						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
1	nB	53.1800	4639.01	+20	4639.21	...	n B	51.2564	4638.58	+16	4638.74	38.98	− 2	4638.96
...	nn D	53.2447	4640.07	+20	4640.27	...	w D	51.3495	4640.41	+17	4640.61	40.57	− 2	4640.55
...	....	....	....	....	....	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	...	....	....	....	....	....	.....	....	....
...	....	....	....	....	....	...	....	....	....	....	....	36.58	− 2	4736.6
...	....	....	....	....	....	...	....	....	....	....	....	38.43	− 2	4738.4
...	....	....	....	....	....	...	....	....	....	....	....	39.52	− 2	4739.50
...	....	....	....	....	....	...	....	....	....	....	....	41.38	− 2	4741.3
...	....	....	....	....	....	...	....	....	....	....	....	40.40	− 2	4740.4
...	....	....	....	....	....	...	....	....	....	....	....	45.49	− 2	4745.4
...	....	....	....	....	....	...	....	....	....	....	....	47.07	− 2	4747.05
...	....	....	....	....	....	...	....	....	....	....	....	49.35	− 2	4749.3
10	D	59.5727	4751.44	+35	4751.79	...	w D	57.6313	4750.76	+55	4751.31	51.61	− 2	4751.59
...	Head	59.6444	4752.79	+35	4753.14	...	Head	57.7213	4752.45	+56	4753.01	53.08	− 2	4753.06
1	n D	59.8052	4755.82	+36	4756.18	2	n B	57.8319	4754.53	+56	4755.09	55.09	− 2	4755.07
...	....	....	....	....	....		n D	57.8842	4755.52	+56	4756.08	56.13	− 2	4756.11
4	B	59.8510	4756.69	+36	4757.05	4	n B	57.9359	4756.50	+56	4757.06	57.06	− 2	4757.04
3	n D	59.9817	4759.17	+36	4759.53	1	n D	58.0577	4758.80	+56	4759.36	59.36	− 2	4759.34
...	wn B	60.0465	4760.40	+36	4760.76	4	wn B	58.1228	4760.04	+57	4760.61	60.82	− 2	4760.80
2	D	60.1305	4762.00	+36	4762.36	...	....	....	....	....	....	62.36	− 2	4762.34
3	n B	60.1845	4763.03	+36	4763.39	3	B	58.2691	4762.82	+57	4763.39	63.39	− 2	4763.37
...	nn D	60.2373	4764.03	+36	4764.39	1	n D	58.3085	4763.57	+57	4764.14	64.27	− 2	4764.45
3	n B	60.2969	4765.17	+36	4765.53	...	....	....	....	....	....	65.47	− 2	4765.45
2-3	n D	60.3575	4766.33	+36	4766.69	1	n D	58.4280	4765.85	+57	4766.42	66.56	− 2	4766.54
...	....	....	....	....	....	2	n B	58.5080	4767.38	+58	4767.96	67.96	− 2	4767.94
1	n D	60.4615	4768.32	+36	4768.68	...	....	....	....	....	....	68.68	− 2	4768.66
...	....	....	....	....	....	1	n B	58.5907	4768.96	+58	4769.54	69.60	− 2	4769.58
3	n B	60.7943	4774.73	+36	4775.09	5	n B	58.8769	4774.47	+59	4775.06	75.20	− 2	4775.18
2	n D	60.8794	4776.38	+37	4776.75	...	....	....	....	....	....	76.84	− 2	4776.82
...	....	....	....	....	....	1	n B	59.0264	4777.36	+59	4777.95	77.95	− 2	4777.93
...	nn D	61.0210	4779.12	+37	4779.49	...	....	....	....	....	....	79.61	− 2	4779.59
Max	B	61.1822	4782.26	+37	4782.63	4	n B	59.2639	4781.97	+60	4782.57	82.62	− 2	4782.60
1	n D	61.2984	4784.52	+37	4784.89	...	....	....	....	....	....	84.86	− 2	4784.84
1	n D	61.3982	4786.48	+37	4786.85	...	....	....	....	....	....	86.85	− 2	4786.83
...	nn D	61.5374	4789.21	+37	4789.58	1-2	n D	59.6324	4789.18	+60	4789.78	89.68	− 2	4789.66
...	....	....	....	....	....	...	....	....	....	....	....	91.66	− 2	4791.64
...	....	....	....	....	....	...	nn D	59.7952	4792.37	+60	4792.97	92.97	− 2	4792.95
...	....	....	....	....	....	...	....	....	....	....	....	95.78	− 2	4795.76
...	nn D	62.0592	4799.52	+37	4799.89	...	....	....	....	....	....	99.89	− 2	4799.87
1	n D	62.2115	4802.55	+37	4802.92	...	....	....	....	....	....	02.92	− 2	4802.90
...	nn D	62.3107	4804.53	+37	4804.90	1	n D	60.3925	4804.23	+62	4804.85	04.88	− 2	4804.86
...	nn D	62.4029	4806.37	+37	4806.74	1	n D	60.4774	4805.91	+62	4806.53	06.64	− 2	4806.62
...	nn D	62.8620	4815.62	+37	4815.99	1	n D	60.9689	4815.80	+62	4816.42	16.17	− 2	4816.15
...	....	....	....	....	....	...	....	....	....	....	....	22.79	− 2	4822.77
...	nn D	63.2535	4823.57	+37	4823.94	2	n D	61.3327	4823.19	+62	4823.81	23.88	− 2	4823.86
	from	63.2930	4821.38	+37	4824.75	...	B	61.4160	4824.89	+62	4825.51	24.75	− 2	4824.7
B	....	....	....	....	....	...	....	....	....	....	....	25.87	− 2	4825.85
	to	63.3985	4826.54	+37	4826.91	...	....	....	....	....	....	26.91	− 2	4826.9
2	n D	63.4327	4827.24	+37	4827.61	1	n D	61.5210	4827.04	+62	4827.66	27.92	− 2	4827.90
2-3	n B	63.5830	4830.32	+37	4830.69	6	n B	61.6592	4829.87	+62	4830.49	30.58	− 2	4830.56
5	n D	63.6652	4832.02	+37	4832.39	6	D	61.7464	4831.67	+62	4832.29	32.48	− 2	4832.46
Con.	from	63.7715	4834.21	+37	4834.58	...	....	....	....	....	....	34.58	− 2	4834.6
...	....	....	....	....	....	0	n D	62.0692	4838.34	+61	4838.95	38.95	− 2	4838.93
Spec.	to	64.1420	4841.90	+37	4842.27	...	....	....	....	....	....	42.27	− 2	4842.3
...	nn D	64.2053	4843.22	+37	4843.59	2	n D	62.2755	4842.63	+61	4843.24	43.50	− 2	4843.48
2	n B	64.2782	4844.74	+37	4845.11	...	....	....	....	....	....	45.18	− 2	4845.16
Con.	from	64.3135	4845.48	+36	4845.84	...	....	....	....	....	....	45.84	− 2	4845.8
Spec.	to	64.5650	4850.75	+36	4851.11	...	....	....	....	....	....	51.11	− 2	4851.1
...	nn D	64.5997	4851.48	+36	4851.84	...	....	....	....	....	....	51.93	− 2	4851.91
...	....	....	....	....	....	...	....	....	....	....	....	56.10	− 2	4856.08
Con.	from	64.8325	4856.39	+36	4856.75	...	....	....	....	....	....	56.75	− 2	4856.7
...	....	....	....	....	....	...	....	....	....	....	....	58.07	− 2	4858.05
Spec.	to	64.9455	4858.79	+36	4859.15	...	....	....	....	....	....	59.15	− 2	4859.1
1	n D	64.9647	4859.20	+36	4859.56	...	....	....	....	....	....	59.67	− 2	4859.65
1-2	n B	65.0206	4860.38	+36	4860.74	...	....	....	....	....	....	60.74	− 2	4860.72

152 *SCHJELLERUP — Continued*

PLATE G 316

Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length
		mm.	t.m.		t.m.
1	n D	40.1160	4862.22	+16	4862.38
1	n D	40.0289	4865.10	+15	4865.25
...	....	....	....	....	....
...	....	....	....	....	....
4	D	39.8491	4871.11	+14	4871.25
2	D	39.7203	4875.44	+13	4875.57
1	D	39.6320	4878.42	+12	4878.54
2	B	39.6013	4879.46	+12	4879.58
5	D	39.5128	4881.44	+12	4881.56
5	B	39.4800	4883.57	+12	4883.69
...	....	....	....	....	....
3-4	D	39.4144	4885.80	+11	4885.91
...	....	....	....	....	....
...	....	....	....	....	....
...	....	....	....	....	....
...	....	....	....	....	....
3-4	B	39.1854	4893.64	+ 9	4893.73
...	....	....	....	....	....
6-8	w B	39.0383	4898.71	+ 9	4898.80
...	....	....	....	....	....
3	D	38.9761	4900.86	+ 8	4900.94
...	....	....	....	....	....
7	B	38.8935	4903.73	+ 7	4903.80
...	....	....	....	....	....
4	n D	38.8123	4906.55	+ 6	4906.61
...	....	....	....	....	....
2	n D	38.7063	4910.25	+ 5	4910.30
4-5	nn D	38.4139	4920.54	+ 2	4920.56
...	....	....	....	....	....
...	....	....	....	....	....
...	....	....	....	....	....
2	n B	37.7610	4943.91	− 5	4943.86
1-2	nn D	37.7064	4945.90	− 7	4945.83
1-2	B	37.6511	4947.90	− 7	4947.83
...	....	....	....	....	....
...	....	....	....	....	....
2	B	37.5382	4952.03	− 9	4951.94
1	n D	37.4760	4954.30	−10	4954.20
2	n D	37.3805	4957.81	−11	4957.70
End	....	36.8590	4977.2	−19	4977.0

PLATE G 394

Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length
		mm.	t.m.		t.m.
1	n D	43.1853	4862.43	+ 4	4862.47
1	n D	43.1010	4865.16	+ 3	4865.19
1	nn D	43.0128	4868.23	+ 3	4868.26
...	....	....	....	....	....
4	D	42.9122	4871.63	+ 3	4871.66
...	....	....	....	....	....
1	D	42.7171	4878.25	+ 2	4878.27
...	....	....	....	....	....
4	w D	42.6121	4881.84	+ 2	4881.86
3	B	42.5533	4883.86	+ 2	4883.88
...	....	....	....	....	....
6	w D	42.4864	4886.16	+ 1	4886.17
...	....	....	....	....	....
2	B	42.4250	4888.27	+ 1	4888.28
...	....	....	....	....	....
	B from	42.3120	4892.18	+ 1	4892.19
	....	....	....	....	....
	....	....	....	....	....
	....	....	....	....	....
	B to	42.0790	4900.28	0	4900.28
3	D	42.0420	4901.56	0	4901.56
...	....	....	....	....	....
4	w B	41.9713	4904.04	− 1	4904.03
...	....	....	....	....	....
3	w D	41.8992	4906.57	− 1	4906.56
...	....	....	....	....	....
4	w D	41.7683	4911.18	− 2	4911.16
...	....	....	....	....	....
1-2	n D	41.3203	4927.13	− 4	4927.09
1-2	n B	41.2587	4929.34	− 5	4929.29
...	....	....	....	....	....
...	....	....	....	....	....
1	n D	40.8027	4915.89	− 7	4945.82
...	....	....	....	....	....
...	....	....	....	....	....
...	....	....	....	....	....
...	....	....	....	....	....
2	n D	40.5741	4954.30	− 9	4954.21
...	....	....	....	....	....
End	....	39.9740	4976.8	−13	4976.7

152 *SCHJELLERUP—Continued*

Plate A 313						Plate A 319						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Formula	Cor. from Curve	Wave-Length	Uncorrected for Velocity	Cor. for V	Corrected for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
...	nn D	65.0867	4861.79	+36	4862.15	...	...	...	...	...	...	62.31	−2	4862.29
...	nn D	65.2159	4864.55	+35	4864.90	...	...	...	...	...	...	65.11	−2	4865.09
...	nn D	65.3530	4867.48	+35	4867.83	...	nn D	63.4397	4867.23	+57	4867.80	67.96	−2	4867.94
...	...	...	...	...	...	3	n B	63.4955	4868.42	+57	4868.99	68.99	−2	4868.97
3	wn D	65.5204	4871.07	+34	4871.41	...	nn D	63.5905	4870.46	+57	4871.03	71.34	−2	4871.32
2	n D	65.7120	4875.20	+34	4875.54	...	nn D	63.7809	4874.57	+56	4875.13	75.35	−2	4875.33
...	nn D	65.8364	4877.89	+33	4878.22	...	...	...	...	...	...	78.34	−2	4878.32
1–2	n B	65.9035	4879.35	+33	4879.68	4	n B	63.9845	4878.97	+56	4879.53	79.63	−2	4879.61
5–6	n D	65.9855	4881.13	+33	4881.46	7	D	64.0649	4880.72	+55	4881.27	81.54	−2	4881.52
2–3	n B	66.0672	4882.91	+33	4883.24	5	n B	64.1542	4882.66	+55	4883.21	83.51	−2	4883.49
	from	66.1160	4884.20	+32	4884.52	...	...	...	...	...	...	84.52	−2	4884.5
D	...	...	...	...	...	3–4	D	64.2942	4885.28	+54	4885.82	85.97	−2	4885.95
	to	66.2525	4886.95	+32	4887.27	...	...	...	...	...	...	87.27	−2	4887.3
2–3	n B	66.2853	4887.67	+32	4887.99	4	n B	64.3655	4887.27	+54	4887.81	88.06	−2	4888.04
...	nn D	66.3480	4889.00	+32	4889.32	1	n D	64.5034	4890.30	+53	4890.83	90.1	−2	4890.1
Con.	from	66.4660	4891.60	+32	4891.92	...	...	...	...	...	...	92.06	−2	4892.0
...	...	...	...	...	...	...	...	...	...	...	...	93.73	−2	4893.71
Spec.	to	66.6240	4895.10	+31	4895.41	...	...	...	...	...	...	95.41	−2	4895.4
3–4	n B	66.7787	4898.53	+31	4898.84	4	B	64.8534	4898.02	+51	4898.53	98.72	−2	4898.70
...	...	...	...	...	...	...	...	...	...	...	...	00.28	−2	4900.3
...	wn D	66.8780	4900.73	+31	4901.04	3	n D	64.9767	4900.75	+50	4901.25	01.20	−2	4901.18
	from	66.9325	4901.95	+30	4902.25	...	...	...	...	...	...	02.25	−2	4902.2
B	...	...	...	...	...	5	n B	65.0814	4903.08	+49	4903.57	03.80	−2	4903.78
	to	67.0510	4904.58	+30	4904.88	...	...	...	...	...	...	04.88	−2	4904.9
...	wn D	67.1070	4905.83	+30	4906.13	...	...	...	...	...	...	06.43	−2	4906.41
3	n B	67.2142	4908.23	+29	4908.52	3–4	B	65.2967	4907.89	+47	4908.36	08.44	−2	4908.42
3	n D	67.3092	4910.36	+29	4910.65	...	nn D	65.3838	4909.84	+47	4910.31	10.61	−2	4910.59
...	...	...	...	...	...	...	...	...	...	...	...	20.56	−2	4920.54
...	...	...	...	...	...	...	wnD	66.1150	4926.39	+40	4926.79	26.94	−2	4926.92
2	n B	68.1255	4928.85	+26	4929.11	...	n B	66.2062	4928.47	+39	4928.86	29.09	−2	4929.07
...	nn D	68.1936	4930.43	+26	4930.69	2	n D	66.3024	4930.67	+38	4931.05	30.87	−2	4930.85
...	...	...	...	...	...	...	...	...	...	...	...	43.86	−2	4943.84
...	nn D	68.8315	4945.13	+23	4945.36	2	n D	66.9292	4945.16	+32	4945.48	45.62	−2	4945.60
...	...	...	...	...	...	...	...	...	...	...	...	47.83	−2	4947.81
...	...	...	...	...	...	2	n D	67.0518	4948.02	+31	4948.33	48.39	−2	4948.37
...	nn D	69.0174	4949.47	+22	4949.69	3	n D	67.1088	4949.32	+30	4949.62	49.66	−2	4949.64
...	...	...	...	...	...	...	B	67.2065	4951.63	+29	4951.82	51.88	−2	4951.86
...	nn D	69.1897	4953.50	+21	4953.71	1	n D	67.2804	4953.37	+28	4953.65	53.94	−2	4953.92
...	...	...	...	...	...	...	...	...	...	...	...	57.70	−2	4957.68
End	...	70.1385	4976.03	+16	4976.19	End	...	68.2360	4976.10	+16	4976.3	...	...	...

152 *SCHJELLERUP*

Plate G 275 1899, January 14, G.M.T. 22h2 Hour angle, E 0h8 Star excellent; comparison good						Plate G 291 1899, January 26, G.M.T. 20h8 Star good; comparison good						Plate G 302 1899, March 6, G.M.T. 22h8 Hour angle, W 3h3 Star excellent; comparison good						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
Head	....	46.8420	5167.90	+20	5168.10							Head	....	50.7600	5167.50	+16	5167.66	67.88	− 2	5167.86
1	B?	46.8254	5168.55	+23	5168.78							....	....	....	....	....	....	68.72	− 2	5168.70
1	D	46.8024	5169.44	+22	5169.66							1	n D	50.7104	5169.45	+15	5169.60	69.63	− 2	5169.61
2	B?	46.7745	5170.53	+22	5170.75							3	B	50.6802	5170.63	+15	5170.78	70.77	− 2	5170.75
5	n D	46.7061	5173.21	+22	5173.43							8	D	50.6197	5173.00	+15	5173.15	73.29	− 2	5173.27
....	....	....	....	....	....							2	B?	50.5625	5175.25	+14	5175.39	75.45	− 2	5175.43
....	....	....	....	....	....							1	B?	50.4771	5178.61	+13	5178.74	78.76	− 2	5178.74
5-6	n D	46.4331	5183.96	+20	5184.16							3	n D	50.3440	5183.91	+12	5184.03	84.10	− 2	5184.08
6	B	46.3520	5187.18	+19	5187.37							7	B	50.2584	5187.28	+11	5187.39	87.38	− 2	5187.36
1-2	n D	46.3078	5188.93	+19	5189.12							2	D	50.2160	5188.98	+11	5189.09	89.11	− 2	5189.09
7	B	46.2593	5190.87	+19	5191.06							7	B	50.1702	5190.80	+11	5190.91	90.99	− 2	5190.97
6	D	46.2008	5193.20	+18	5193.38							6	D	50.1114	5193.15	+10	5193.25	93.32	− 2	5193.30
1	D	45.9762	5202.21	+17	5202.38							1	nn D	49.8804	5202.44	+ 7	5202.51	02.45	− 2	5202.43
2	B	45.9375	5203.77	+16	5203.93							1-2	B	49.8480	5203.74	+ 7	5203.81	03.87	− 2	5203.85
2-3	n D	45.8877	5205.78	+16	5205.94							....	....	....	....	....	....	05.88	− 2	5205.86
2	B	45.6743	5214.44	+14	5214.58							5	B	49.5894	5214.24	+ 3	5214.27	14.43	− 2	5214.41
5	n D	45.6144	5216.88	+14	5217.02							4	n D	49.5300	5216.66	+ 3	5216.69	16.86	− 2	5216.84
2-3	wn B	45.5598	5219.11	+12	5219.23							4	B	49.4726	5219.02	+ 2	5219.04	19.14	− 2	5219.12
5	wn D	45.3686	5226.96	+10	5227.06							5	D	49.2796	5226.95	− 1	5226.94	27.00	− 2	5226.98
4	B	45.2891	5230.12	+ 9	5230.21							6	B	49.1986	5230.31	− 2	5230.29	30.25	− 2	5230.23
4	D	45.2109	5233.48	+ 8	5233.56							5	D	49.1245	5233.38	− 3	5233.35	33.46	− 2	5233.44
9	B	45.1470	5236.13	+ 7	5236.20							10	B	49.0537	5236.32	− 4	5236.28	36.24	− 2	5236.22
....	....	....	....	....	....							1-2	n D	48.9896	5238.99	− 5	5238.94	39.00	− 2	5238.98
1-2	n B	44.9386	5244.83	+ 2	5244.85							3	B	48.8455	5245.02	− 9	5244.93	44.89	− 2	5244.87
5	D	44.8799	5247.29	+ 1	5247.30							6	D	48.7921	5247.26	−10	5247.16	47.23	− 2	5247.21
4	B	44.8316	5249.32	+ 1	5249.33							5	B	48.7448	5249.25	−11	5249.14	49.24	− 2	5249.22
8	D	44.7830	5251.36	0	5251.36							7	D	48.6936	5251.41	−12	5251.29	51.33	− 2	5251.31
1	n D	44.6881	5255.37	− 1	5255.36							2	D	48.5985	5255.43	−14	5255.29	55.33	− 2	5255.31
1	nn D	44.4336	5266.19	− 4	5266.15							1	D	48.3382	5266.51	−18	5266.33	66.24	− 2	5266.22
4	D	44.3407	5270.16	− 5	5270.11							5	D	48.2514	5270.23	−20	5270.03	70.07	− 2	5270.05
....	....	....	....	....	....							2	n B	48.1945	5272.67	−21	5272.46	72.52	− 2	5272.50
....	....	....	....	....	....							2	n B	48.0329	5279.65	−22	5279.43	79.49	− 2	5279.47
1	nn D?	44.0833	5281.25	− 7	5281.18							....	....	....	....	....	....	81.12	− 2	5281.10
1	n D	44.0056	5284.62	− 8	5284.54							1-2	n D	47.9213	5284.49	−23	5284.26	84.35	− 2	5284.33
....	....	....	....	....	....							1	n D?	47.6986	5294.21	−24	5293.97	94.03	− 2	5294.01
....	....	....	....	....	....							2	n D	47.6214	5297.60	−24	5297.36	97.42	− 2	5297.40
1	B?	43.5692	5303.73	−10	5303.63							2	B?	47.4755	5304.04	−23	5303.81	03.72	− 2	5303.70
4	B	43.3509	5313.41	−10	5313.31							4	B	47.2656	5313.35	−22	5313.13	13.22	− 2	5313.20
3	D	43.3021	5315.59	−10	5315.49							3	n D	47.2163	5315.56	−22	5315.34	15.42	− 2	5315.40
....	....	....	....	....	....							1-2	B	47.1719	5317.54	−22	5317.32	17.38	− 2	5317.36
....	....	....	....	....	....							1	D	46.9975	5325.37	−20	5325.17	25.23	− 2	5325.21
2	n D	43.0076	5328.81	− 8	5328.73							3	D	46.9263	5328.58	−19	5328.39	28.56	− 2	5328.54
4	B	42.8610	5335.45	− 7	5335.38							3	B	46.7763	5335.38	−18	5335.20	35.27	− 2	5335.25
1	n D	42.8149	5337.54	− 6	5337.48							1-2	n D	46.7338	5337.32	−17	5337.15	37.32	− 2	5337.30
6	B	42.7732	5339.41	− 6	5339.38							7	B	46.6864	5339.47	−16	5339.31	39.35	− 2	5339.33
4-5	D	42.7259	5341.60	− 5	5341.55							7	D	46.6339	5341.87	−16	5341.71	41.63	− 2	5341.61
5-6	B	42.6648	5344.39	− 4	5344.35							6	B	46.5774	5344.46	−15	5344.31	44.33	− 2	5344.31
3	n B	42.4884	5352.50	− 2	5352.48							3-4	B	46.4091	5352.19	−13	5352.06	52.27	− 2	5352.25
1	nn D	42.2715	5362.54	+ 1	5262.55							1	n D	46.1844	5362.60	−12	5362.48	62.52	− 2	5362.50
1-2	n B?	42.2295	5364.49	+ 2	5364.51							1-2	B?	46.1480	5364.29	−11	5364.18	64.35	− 2	5364.33
3	n D	42.1837	5366.63	+ 2	5366.65							3-4	D	46.0929	5366.87	− 9	5366.78	66.72	− 2	5366.70
8	B	42.1300	5369.14	+ 3	5369.17							10	B	46.0439	5369.16	− 8	5369.08	69.13	− 2	5369.11
7	D	42.0667	5372.10	+ 4	5372.14							9	D	45.9796	5372.17	− 7	5372.10	72.12	− 2	5372.10
6	B	42.0040	5375.04	+ 5	5375.09							8	B	45.9200	5374.96	− 6	5374.90	75.00	− 2	5374.98
3	D	41.9612	5377.06	+ 6	5377.12							4	D	45.8744	5377.11	− 6	5377.05	77.09	− 2	5377.07
3	B	41.9218	5378.92	+ 6	5378.98							2-3	B	45.8356	5378.94	− 5	5378.89	78.94	− 2	5378.92
3	B	41.8679	5381.46	+ 7	5381.53							2-3	B	45.7828	5381.44	− 5	5381.39	81.46	− 2	5381.44
D }	from	41.8390	5382.90	+ 8	5382.98							....	....	....	....	....	....	82.92	− 2	5382.9
	to	41.5560	5396.30	+10	5396.40							....	....	....	....	....	....	96.34	− 2	5396.3
3	D	41.5236	5397.85	+11	5397.96							2-3	n D	45.4383	5397.81	0	5397.84	97.90	− 2	5397.88
2-3	n D	41.3140	5407.94	+13	5408.07							....	nn D	45.2160	5408.54	+ 2	5408.56	08.32	− 2	5408.30
1	n D	41.1879	5414.05	+14	5414.19							1-2	n D	45.1047	5413.94	+ 3	5413.97	14.08	− 2	5414.06
1-2	nn D	41.0663	5419.98	+15	5420.13							2	n D	44.9777	5420.13	+ 4	5420.17	20.15	− 2	5420.13
1-2	B	41.0138	5422.54	+15	5422.69							3	n B	44.9336	5422.29	+ 5	5422.34	22.52	− 2	5422.50
1	n D	40.9760	5424.39	+15	5424.54							1	n D	44.8934	5424.26	+ 5	5424.31	24.43	− 2	5424.41
1	n D	40.8617	5430.01	+16	5430.17							2	D	44.7707	5430.29	+ 6	5430.35	30.26	− 2	5430.24
....	....	....	....	....	....							2	B	44.7333	5432.13	+ 6	5432.19	32.25	− 2	5432.23
1-2	n D	40.7759	5434.25	+16	5434.41							1	n D	44.6900	5434.27	+ 6	5434.33	34.37	− 2	5434.35
....	....	....	....	....	....							2	D	44.5980	5438.82	+ 7	5438.89	38.95	− 2	5438.93
2	n B	40.6067	5442.64	+17	5442.81							2	B	44.5230	5442.55	+ 7	5442.63	42.72	− 2	5442.70
....	wn D	40.5144	5447.22	+17	5447.39							....	w D	44.4110	5446.69	+ 8	5446.77	47.08	− 2	5447.06
2	B	40.4418	5450.87	+17	5451.04							4	B	44.3595	5450.72	+ 8	5450.80	50.92	− 2	5450.90
1	nn D	40.3180	5457.09	+16	5457.25							1	nn D	44.2350	5456.97	+ 8	5457.05	57.15	− 2	5457.13
1	nn D	40.2370	5461.17	+16	5461.33							1	nn D	44.1556	5460.98	+ 9	5461.07	61.20	− 2	5461.18
1	D	39.9809	5474.20	+15	5474.35							1	nn D	43.8910	5474.28	+10	5474.38	71.37	− 2	5474.35
0-1	n B	39.8384	5481.51	+14	5481.65							1	B	43.7538	5481.46	+10	5481.56	81.60	− 2	5481.58
1	B	39.7378	5486.69	+14	5486.83							1	B	43.6429	5487.17	+10	5487.27	87.05	− 2	5487.03
4	B	39.3232	5508.29	+10	5508.39							5-6	B	43.2402	5508.14	+10	5508.24	08.32	− 2	5508.30
1-2	n B	39.1571	5517.05	+ 8	5517.13							....	....	....	....	....	....	.....	...	....
1	nn D	38.8556	5533.11	+ 4	5533.15							1-2	nn D	42.7908	5531.97	+10	5532.07	32.61	− 2	5532.59
....	wn D	38.7397	5539.34	+ 3	5539.37							2-3	n D	42.6563	5539.19	+10	5539.29	39.33	− 2	5539.31
1-2	n D	38.6052	5546.61	+ 1	5546.62							....	wn D	42.5199	5546.55	+ 9	5546.54	46.58	− 2	5546.56
1	D	38.4922	5552.80	0	5552.80							1	D	42.4118	5552.42	+ 9	5552.51	52.66	− 2	5552.64
....	....	....	....	....	....							1	n D	42.3428	5556.18	+ 8	5556.26	56.26	− 2	5556.24
....	....	....	....	....	....							1	n D	42.2285	5562.14	+ 8	5562.52	62.52	− 2	5562.50

152 *SCHJELLERUP—Continued*

Plate G 275						Plate G 291						Plate G 302						Mean Wave-Length		
Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Intensity	Character	Mean Scale Reading	Wave-Length by Form.	Cor. from Curve	Wave-Length	Uncor. for Velocity	Cor. for V	Cor. for Velocity
		mm.	t.m.		t.m.			mm.	t.m.		t.m.			mm.	t.m.		t.m.	t.m.		t.m.
4	n D	38.2416	5568.13	− 3	5568.10	....	....	....	....	....	....	....	....	....	....	....	....	68.10	−2	5568.08
8	w D	38.0700	5575.96	− 4	5575.92	....	....	....	....	....	....	6	nn D	41.9758	5576.37	+ 6	5576.43	76.18	−2	5576.16
8	w D	37.9289	5583.84	− 6	5583.75	....	....	....	....	....	....	10	wn D	41.8455	5583.61	+ 6	5583.67	83.71	−2	5583.69
1	B	37.8593	5587.70	− 7	5587.63	....	....	....	....	....	....	1	n B	41.7761	5587.49	+ 5	5587.54	87.59	−2	5587.57
1	D	37.8356	5589.03	− 7	5588.96	1	n D	37.9875	5589.12	−13	5588.99	4	nn D	41.7509	5588.90	+ 5	5588.95	88.97	−2	5588.95
8	B	37.7906	5591.55	− 7	5591.48	....	....	....	....	....	....	10	n B	41.7067	5591.38	+ 5	5591.43	91.46	−2	5591.44
....	....	....	....	....	....	2	B	37.9233	5592.73	−13	5592.60	....	....	....	....	....	....	92.60	−2	5592.58
D	from	37.4960	5607.97	− 9	5607.88	....	....	....	....	....	....	D {	from	41.4500	5605.85	+ 3	5605.88	06.9	−2	5606.9
1	D	37.3566	5616.17	−10	5616.07	....	....	....	....	....	....		....	....	....	....	....	16.07	−2	5616.0
D {	from	37.3080	5618.94	−10	5618.84	....	....	....	....	....	....		....	....	....	....	....	18.84	−2	5618.8
	to	37.1840	5626.08	−10	5625.98	....	....	....	....	....	....		to	41.1180	5624.83	− 1	5624.82	25.45	−2	5625.4
....	w B	37.1274	5629.36	−12	5629.24	....	....	....	....	....	....	....	w B	41.0492	5628.81	− 1	5628.80	29.02	−2	5629.00
10	w D	37.0485	5633.93	−12	5633.81	10	w D	37.1949	5634.44	−20	5634.24	10	D	40.9713	5633.31	− 2	5633.29	33.78	−2	5633.76
....	Head	37.0060	5636.40	−12	5636.28	....	....	....	....	....	....	....	Head	40.9250	5636.00	− 2	5635.98	36.13	−2	5636.11
....	....	....	....	....	....	5	B	37.1215	5638.71	−20	5638.51	6	B	40.8964	5637.66	− 2	5637.64	38.08	−2	5638.06
....	....	....	....	....	....	1	D	37.0958	5640.22	−21	5640.01	....	....	....	....	....	....	40.01	−2	5639.99
....	....	....	....	....	....	4	B	37.0675	5641.87	−21	5641.66	2–3	B	40.8335	5641.32	− 3	5641.29	41.48	−2	5641.46
....	....	....	....	....	....	2	D	37.0106	5645.20	−20	5645.00	1	n D	40.7841	5644.21	− 4	5644.17	44.59	−2	5644.57
....	....	....	....	....	....	....	....	....	....	....	....	B {	from	40.7460	5646.43	− 4	5646.39	46.39	−2	5646.37
....	....	....	....	....	....	0–1	D	36.9105	5651.09	−22	5650.87		....	....	....	....	....	50.87	−2	5650.85
....	....	....	....	....	....	1–2	D?	36.8551	5654.36	−22	5654.14		....	....	....	....	....	54.14	−2	5654.12
....	....	....	....	....	....	0–1	D	36.8010	5657.56	−22	5657.34		....	....	....	....	....	57.34	−2	5657.32
1	D?	36.5624	5662.47	−14	5662.33	4	D?	36.7140	5662.72	−22	5662.50		....	....	....	....	....	62.41	−2	5662.39
....	....	....	....	....	....	Max	B	36.5999	5669.52	−22	5669.30		....	....	....	....	....	69.30	−2	5669.28
....	....	....	....	....	....	....	....	....	....	....	....		to	40.3430	5670.24	− 7	5670.17	70.17	−2	5670.2
....	....	....	....	....	....	....	....	....	....	....	....	1	nn D	40.3250	5671.31	− 7	5671.24	71.24	−2	5671.22
1	D	36.3416	5675.64	−15	5675.49	2	D	36.4922	5675.97	−23	5675.74	2	nn D	40.2586	5675.28	− 7	5675.21	75.48	−2	5675.46
....	....	....	....	....	....	2	B	36.4297	5679.73	−23	5679.50	....	....	....	....	....	....	79.51	−2	5679.49
2	D	36.1554	5686.85	−15	5686.70	4	D	36.3047	5687.28	−23	5687.05	4	D	40.0777	5686.15	− 8	5686.07	86.61	−2	5686.59
....	....	....	....	....	....	3	n B	36.1968	5693.83	−24	5693.59	5	B	39.9667	5692.87	− 9	5692.78	93.19	−2	5693.17
....	....	....	....	....	....	1	n D	36.1509	5696.62	−25	5696.37	....	D	39.9258	5695.35	− 9	5695.26	95.82	−2	5695.80
....	....	....	....	....	....	....	....	....	....	....	....	1–2	B	39.7661	5705.09	−10	5704.99	04.99	−2	5704.97
1–2	D	35.8047	5708.23	−16	5708.07	2	n D	35.9556	5708.58	−26	5708.32	4	D	39.7275	5707.45	−10	5707.35	07.91	−2	5707.89
2	B	35.7656	5710.63	−16	5710.47	....	....	....	....	....	....	....	....	....	....	....	....	10.47	−2	5710.45
....	nn D	35.7232	5713.25	−16	5713.09	4	n D	35.8881	5712.74	−26	5712.48	1	n D	39.6521	5712.08	−11	5711.97	12.51	−2	5712.49
8	B	35.6632	5716.95	−16	5716.79	6	n B	35.8220	5716.83	−27	5716.56	7	w B	39.5838	5716.29	−11	5716.18	16.51	−2	5716.49
....	....	....	....	....	....	4	n D	35.7505	5721.26	−27	5720.99	1	n D	39.5185	5720.32	−12	5720.20	20.70	−2	5720.68
....	....	....	....	....	....	1	B	35.7057	5724.05	−27	5723.78	6	B	39.4621	5723.82	−12	5723.70	23.82	−2	5723.80
....	....	....	....	....	....	6	w D	35.5739	5732.28	−27	5732.01	4	n D	39.3460	5730.97	−12	5730.87	31.62	−2	5731.60
B {	from	35.3859	5734.30	−16	5734.14	....	....	....	....	....	....	B {	from	39.3000	5733.91	−12	5733.79	33.97	−2	5733.9
	to	35.2600	5742.11	−16	5741.95	....	....	....	....	....	....		to	39.1910	5740.74	−13	5740.61	41.28	−2	5741.3
1	D?	35.2315	5743.92	−16	5743.76	....	....	....	....	....	....	2	D?	39.1564	5742.92	−13	5742.79	43.28	−2	5743.26
1–2	B	35.1883	5746.65	−16	5746.49	....	....	....	....	....	....	2	B	39.1109	5745.79	−13	5745.66	46.08	−2	5746.06
2	n D	35.1414	5749.62	−16	5749.46	....	....	....	....	....	....	3	D	39.0655	5748.66	−13	5748.53	49.00	−2	5748.98
1	n B?	35.0839	5753.27	−16	5753.11	....	....	....	....	....	....	4	n B?	39.0106	5752.13	−14	5751.99	52.55	−2	5752.53
2	n B	35.0224	5757.18	−16	5757.02	....	....	....	....	....	....	4	n B	38.9501	5755.97	−14	5755.83	56.43	−2	5756.41
1	n D?	34.9860	5759.50	−16	5759.34	....	....	....	....	....	....	....	....	....	....	....	....	59.34	−2	5759.32
1–2	n B	34.8645	5767.28	−17	5767.11	....	....	....	....	....	....	....	....	....	....	....	....	67.11	−2	5767.09
2	n D	34.8079	5770.92	−16	5770.76	....	....	....	....	....	....	2	D	38.7363	5769.62	−14	5769.48	70.12	−2	5770.10
3	B	34.7599	5774.02	−17	5773.85	....	....	....	....	....	....	1–2	B	38.6838	5773.00	−15	5772.85	73.35	−2	5773.33
4	B	34.6569	5780.68	−17	5780.51	....	....	....	....	....	....	2	B	38.5768	5779.90	−15	5779.75	80.13	−2	5780.11
4	D	34.5916	5784.92	−17	5784.75	....	....	....	....	....	....	5	w D	38.5189	5783.65	−15	5783.50	84.13	−2	5784.11
2	B?	34.5383	5788.39	−17	5788.22	....	....	....	....	....	....	....	....	....	....	....	....	88.22	−2	5788.20
1	D	34.5060	5790.50	−17	5790.33	....	....	....	....	....	....	1	n D	38.4319	5788.65	−15	5788.50	89.42	−2	5789.40
....	....	....	....	....	....	....	....	....	....	....	....	1	n D	38.3064	5797.50	−16	5797.34	97.34	−2	5797.32
3	B?	34.3474	5800.90	−17	5800.73	....	....	....	....	....	....	2–3	B?	38.2670	5800.08	−16	5799.92	00.32	−2	5800.30
....	....	....	....	....	....	....	....	....	....	....	....	2–3	D?	38.2246	5802.86	−16	5802.70	02.70	−2	5802.68
....	B?	34.1176	5816.11	−16	5815.95	....	....	....	....	....	....	....	....	....	....	....	....	15.95	−2	5815.93
....	....	....	....	....	....	....	....	....	....	....	....	1	D?	38.0135	5816.82	−16	5816.66	16.66	−2	5816.64
....	....	....	....	....	....	....	....	....	....	....	....	1	D	37.9316	5822.27	−16	5822.11	22.11	−2	5822.09
....	B?	33.9529	5827.11	−16	5826.95	....	....	....	....	....	....	....	....	....	....	....	....	26.95	−2	5826.93
....	B?	33.8031	5837.17	−16	5837.01	....	....	....	....	....	....	....	....	....	....	....	....	37.01	−2	5836.99
....	....	....	....	....	....	....	....	....	....	....	....	1	D?	37.3934	5858.62	−16	5858.46	58.46	−2	5858.44
....	....	....	....	....	....	....	....	....	....	....	....	1	D?	37.1202	5877.43	−16	5877.27	77.27	−2	5877.25
....	D?	33.1089	5884.89	−16	5884.73	....	....	....	....	....	....	....	....	....	....	....	....	81.73	−2	5884.71
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	83.6	−2	5883.6
....	End	33.1250	5883.8	−16	5883.6	....	....	....	....	....	....	....	End	36.9760	5887.4	−16	5887.2	87.2	−2	5887.2

DETERMINATION OF THE RADIAL VELOCITIES

The determination of the radial velocities was complicated by the presence of bright lines in the spectra, since the apparent center of a neighboring dark line would be shifted by an amount which would vary with the exposure and consequent density of the negative. To avoid this difficulty as far as possible, dark lines away from bright lines were selected for velocity determinations whenever they were available. The following tables give in detail for each star the lines selected, the elements with which they were identified, the differences in wave-length, and the resulting velocity corrections. The great range for the different lines is partly due to the cause just mentioned, but errors also necessarily arise from the use of lines which blend together in the spectra of these stars, though they are well separated in the solar spectrum. Such blends result from the large slit-widths used with comparatively small dispersion, the increased strength of lines in fourth-type spectra, and the changes of relative intensity as compared with the solar spectrum.

RADIAL VELOCITIES FROM THE DARK LINES

The tables are arranged as follows: The third column, headed $\Delta\lambda$, gives the displacement of the lines in hundredths of a tenth-meter; the fourth column gives the velocity corresponding to a displacement of one tenth-meter; the fifth column gives the deduced velocity, being the product of columns three and four.

19 *PISCIUM*

Star	Element	$\Delta\lambda$	V_1	V
t.m.	t.m.		km.	km.
4404.95	*Fe* 04.94	+ 1	68	+ 1
4408.48	*Fe* 08.60	−12	68	− 8
4415.14	*Fe* 15.33	−19	68	−13
4489.72	*Fe* 89.90	−18	67	−12
4496.99	*Cr* 97.02	− 3	67	− 2
4512.73	*Ti* 12.91	−18	66	−12
4518.24	*Ti* 18.18	+ 6	66	+ 4
4522.97	*Ti* 22.97	0	66	0
4594.31	*V* 94.27	+ 4	66	+ 3
4789.40	*Fe* 89.40 du	0	63	0
5247.53	*Fe* 47.27	+26	57	+15
5397.54	*Fe* 97.70 tr	−26	56	−14
5406.39	*Fe* 05.98	+41	55	+22
5430.35	*Fe* 29.81	+54	55	+30
5731.16	*Fe* 31.98	−82	52	−43

16 lines, Mean −2 km.

318 *BIRMINGHAM*

Star	Element	$\Delta\lambda$	V_1	V
t.m.	t.m.		km.	km.
4405.00	*Fe* 04.94	+ 6	68	+ 4
4414.96	*Fe* 15.33	−37	68	−25
4496.82	*Cr* 97.02	−20	67	−13
4512.49	*Ti* 12.88	−39	66	−26
4518.16	*Ti* 18.18	− 2	66	− 1
4522.91	*Ti* 22.97	− 6	66	− 4
4531.18	*Fe* 31.31	−13	66	− 9
4920.62	*Fe* 20.69	− 7	61	− 4
4934.31	*Ba* 34.24	+ 7	61	+ 4
5173.46	*Ti* 73.94	−48	58	−28
5193.26	*Ti* 93.15	+11	58	+ 6
5251.10	*Ti* 50.83	+27	57	+16
5255.42	*Ti* 55.15	+27	57	+16
5269.84	*Ti* 69.72	+12	57	+ 7
5297.59	*Cr* 98.15	−56	57	−32
5328.52	*Fe* 28.38	+14	56	+ 8
5396.93	*Fe* 97.32	−39	56	−22
5110.19	*Fe* 10.53	−34	55	−19

19 lines, Mean −8 km.

280 *SCHJELLERUP*

Star	Element	$\Delta\lambda$	V_1	V
t.m.	t.m.		km.	km.
4434.85	*Fe* 35.33	−47	68	−32
4512.45	*Ti* 12.88	−43	66	−28
4517.77	*Ti* 18.18	−41	66	−27
4522.53	*Ti* 22.97	−44	66	−29
4605.88	*Fe* 06.40	−52	65	−34
4645.67	*Fe* 46.40	−73	64	−47
4667.76	*Fe* 67.96	−20	64	−13
4681.77	*Fe* 82.24	−47	64	−30
4714.10	*Ni* 14.59	−49	64	−31
4728.22	*Fe* 28.73	−51	63	−32
5297.72	*Cr* 98.15	−43	57	−25
5349.99	*Fe* 49.89	+10	56	+ 6
5371.62	*Fe* 71.68	− 6	56	− 3
5397.02	*Fe* 97.32	−30	56	−17
5405.81	*Fe* 05.97	−16	55	− 9
5110.10	*Fe* 10.52	−42	55	−23

16 lines, Mean −25 km.

74 *SCHJELLERUP*

Star	Element	$\Delta\lambda$	V_1	V
t.m.	t.m.		km.	km.
4395.13	*Ti* 95.19	− 6	68	− 4
4115.38	*Fe* 15.33	+ 5	68	+ 3
4497.29	*Cr* 97.02	+27	67	+18
4512.43	*Ti* 12.88	−45	66	−30
4518.46	*Ti* 18.18	+28	66	+18
4523.23	*Ti* 22.97	+31	66	+20
4527.45	*Ti* 27.48	− 3	66	− 2
4565.82	*Fe* 65.87	− 5	66	− 3
4789.34	*Fe* 89.37	− 3	63	− 2
4832.65	*Fe* 32.90	−25	62	−15
5173.31	*Mg* 72.86	+45	58	+26
5251.76	*Fe* 51.49	+27	57	+15
5270.17	*Fe* 70.11	+ 8	57	+ 5

13 lines, Mean +4 km.

78 *SCHJELLERUP*

Star	Element	Δλ	V_1	V
t.m.	t.m.		km.	km.
4415.17	*Fe* 15.33	−16	68	−11
4455.50	*Ti* 55.48	+ 2	67	+ 1
4496.95	*Cr* 97.02	− 7	67	− 5
4512.92	*Ti* 12.88	+ 4	66	+ 3
4518.19	*Ti* 18.18	+ 1	66	+ 1
4523.02	*Ti* 22.97	+ 5	66	+ 3
4527.27	{ *Ca* 27.10 / *Ti* 27.49	− 3	66	− 2
4784.52	*V* 84.65	−13	63	− 8
5183.92	*Mg* 83.79	+15	58	+ 9
5189.15	*Ca* 89.05	+10	58	+ 6
5233.95	*V* 33.91	+ 4	57	+ 2
5349.55	*Ca* 49.65	−10	56	− 6
5731.46	*V* 31.48	− 2	52	− 1

13 lines, Mean −1 km.

115 *SCHJELLERUP*

Star	Element	Δλ	V_1	V
t.m.	t.m.		km.	km.
4435.28	*Fe* 35.33	− 5	68	− 3
4496.84	*Cr* 97.02	−18	67	−12
4512.85	*Ti* 12.88	− 3	66	− 2
4518.01	*Ti* 18.18	−17	66	−11
4522.88	*Ti* 22.97	− 9	66	− 6
4553.89	*Ba* 54.21	−32	66	−21
5183.38	*Mg* 83.79	−41	58	−24
5731.72	*Fe* 31.98	−26	52	−14

8 lines, Mean −12 km.

132 *SCHJELLERUP*

Star	Element	Δλ	V_1	V
t.m.	t.m.		km.	km.
4397.83	*V* 98.35	−35	68	−24
4404.52	*Fe* 04.94	−42	68	−29
4408.25	*Fe* 08.60	−35	68	−24
4414.66	*Fe* 15.33	−67	68	−46
4454.53	*Ca* 54.95	−42	67	−28
4489.46	*Fe* 89.90	−44	67	−29
4496 44	*Cr* 97.02	−58	67	−39
4512.35	*Ti* 12.88	−53	66	−36
4517.67	*Ti* 18.18	−51	66	−34
4522.57	*Ti* 22.97	−40	66	−26
4528.27	*Fe* 28.84	−57	66	−38
4552.42	*Fe* 52.72	−30	66	−20
4593.67	*V* 94.27	−60	65	−39
4656.03	*Ti* 56.64	−61	64	−39
4924.13	*Fe* 24.39	−26	61	−16
4933.02	*Fe* 33.50	−48	61	−29
5172.36	*Mg* 72.86	−50	58	−29
5246.92	*Fe* 47 27	−35	57	−19
5297.61	*Cr* 98.15	−54	57	−31
5328.56	*Fe* 28.71	−15	56	− 9
5397.47	*Fe* 97.70	−23	56	−13

21 lines, Mean −28 km.

152 *SCHJELLERUP*

Star	Element	Δλ	V_1	V
t.m.	t.m.		km.	km.
4489.63	*Fe* 89.90	−27	67	−18
4512.83	*Ti* 12.88	− 5	66	− 3
4518.25	*Ti* 18.18	+ 7	66	+ 5
4552.67	*Fe* 52.72	+ 5	66	+ 3
4593.95	*V* 94.27	−32	65	−22
4789.68	*Fe* 89.80	−12	63	− 8

6 lines, Mean, wt. 2, −9 km.

5173.29	*Mg* 72.86	+43	58	+25
5202.45	*Fe* 02.49	− 4	58	− 2
5247.23	*Fe* 47.27	− 4	57	− 2
5270.07	*Fe* 69.99	+ 8	57	+ 5
5328.56	*Fe* 28.71	−15	56	− 8
5430.26	*Fe* 29.81	+45	55	+25
5686.61	*Fe* 86.66	− 5	53	− 3

7 lines, Mean, wt. 1, +6
Weighted mean, −4 km.

RADIAL VELOCITIES FROM THE BRIGHT LINES

Comparison with 132 *Schjellerup*

As a check on these very unsatisfactory results, the bright lines of the other stars were compared with the bright lines of 132 *Schjellerup*. The following table gives this comparison, with the velocities resulting from the use of the value −28 km., adopted for 132 *Schjellerup*.

RADIAL VELOCITIES FROM THE BRIGHT LINES

132 *Schj.*	19 *Pisc.*		318 *Birm.*		74 *Schj.*		78 *Schj.*		115 *Schj.*		152 *Schj.*	
	λ	Δλ	λ	Δλ	λ	Δλ	λ	Δλ	λ	Δλ	λ	Δλ
t.m.	t.m.		t.m.		t.m.		t.m.		t.m.		t.m.	
4402.03	.....	....	02.32	+29	02.68	+65	.....	....	.....	....	.....	....
4437.05	.....	....	37.21	+16	.....	....	.....	....	.....	....	.....	....
4438.45	38.86	+41	38.95	+50	.....	....	.....	....	.....	....	.....	....
4448.24	.....	....	48.46	+24	48.95	+71	.....	....	.....	....	.....	....
4463.65	64.01	+36	.....	....	.....	....	.....	....	.....	....	64.23	+58
4488.29	88.58	+29	.....	....	.....	....	.....	....	.....	....	88.92	+63
4521.23	.....	....	21.52	+29	.....	....	.....	....	.....	....	.....	....
4524.26	.....	....	.....	....	.....	....	.....	....	.....	....	24.69	+43
4536.55	.....	....	.....	....	.....	....	.....	....	.....	....	.....	....
4537.06	.....	....	37.23	+42	.....	....	.....	....	36.98	+17	.....	....
4538.57	38.97	+40	38.74	+17	.....	....	.....	....	.....	....	39.24	+67
4547.19	47.76	+57	.....	....	.....	....	47.73	+52	47.61	+42	47.78	+59
4578.09	.....	....	.....	....	.....	....	.....	....	.....	....	78.64	+55
4579.26	.....	....	.....	....	.....	....	.....	....	.....	....	79.75	+49
4580.77	.....	....	.....	....	.....	....	.....	....	.....	....	81.27	+50
4583.49	83.61	+15	.....	....	.....	....	.....	....	.....	....	83.94	+45
4585.07	85.38	+31	.....	....	.....	....	.....	....	.....	....	.....	....
4614.73	.....	....	15.00	+27	.....	....	.....	....	.....	....	.....	....
4617.78	.....	....	.....	....	18.07	+29	18.07	+29	.....	....	18.21	+43
4621.09	21.32	+23	21.41	+32	21.66	+57	21.49	+40	.....	....	.....	....
4638.57	38.72	+15	39.04	+47	39.11	+54	39.13	+56	.....	....	38.88	+31
4641.47	41.71	+24	.....	....	.....	....	42.08	+61	.....	....	.....	....
4664.82	65.38	+56	.....	....	.....	....	.....	....	.....	....	.....	....
4738.39	.....	....	38.63	+24	.....	....	38.93	+54	38.72	+33	.....	....
4829.86	.....	....	30.30	+44	.....	....	.....	....	.....	....	30.59	+73
5312.93	.....	....	.....	....	.....	....	13.05	+12	.....	....	.....	....
5317.26	17.87	+61	17.39	+13	17.59	+33	17.56	+30	17.58	+32	.....	....
5368.55	.....	....	68.50	− 5	.....	....	68.91	+36	.....	....	69.13	+58
5374.65	75.31	+69	74.74	+ 9	.....	....	75.03	+38	74.78	+13	75.00	+35
5379.96	.....	....	.....	....	.....	....	80.45	+49	.....	....	.....	....
5411.89	.....	....	.....	....	.....	....	.....	....	12.07	+18	.....	....
5416.56	.....	....	.....	....	17.11	+55	.....	....	.....	....	.....	....
5422.55	23.19	+64	22.60	+ 5	.....	....	.....	....	.....	....	.....	....
5431.75	.....	....	31.96	+20	.....	....	.....	....	.....	....	32.25	+50
5450.40	.....	....	.....	....	.....	....	.....	....	50.65	+15	50.92	+52
5564.02	64.45	+43	.....	....	64.83	+81	.....	....	.....	....	.....	....
5586.45	86.93	+48	86.77	+32	86.99	+51	87.21	+76	.....	....	.....	....
5692.68	.....	....	.....	....	.....	....	.....	....	.....	....	93.19	+51
5710.18	.....	....	10.62	+44	.....	....	.....	....	.....	....	.....	....
Mean Δ, t.m..........	+.41		+.26		+.56		+.45		+.24		+.52	
Mean Δ, km..........	+26		+16		+34		+27		+14		+33	
V of 132 *Schj*........	−28		−28		−28		−28		−28		−28	
Velocity in km.......	− 2		−12		+ 6		− 1		−14		+ 5	

RADIAL VELOCITY OF 280 *SCHJELLERUP*

From bright lines compared with 19 *Piscium*

The character of the spectrum of 280 *Schjellerup* differs so much from that of 132 *Schjellerup* that direct comparison of the bright lines was unsatisfactory; therefore they were compared with the lines in 19 *Piscium*, a star more nearly like 280 *Schjellerup* in development.

19 *Piscium*	280 *Schjellerup*	Δλ	19 *Piscium*	280 *Schjellerup*	Δλ
t.m.	t.m.	t.m.	t.m.	t.m.	t.m.
4617.77	17.36	− .41	5531.92	31.20	− .72
4631.12	30.59	− .53	5571.81	71.57	− .24
4638.72	37.65	−1.07	5580.71	81.09	− .38
4660.88	60.09	− .79	5724.08	23.96	− .12
5453.81	52.18	−1.63	5756.98	57.57	− .59
5459.10	58.61	− .49			

Mean − .46 t.m.
= −25 km.

MEAN RADIAL VELOCITIES

The final adopted velocities are the means of the direct determinations by dark lines and the comparison of the bright lines with those of 132 *Schjellerup*. The close agreement in certain stars of the results obtained with the dark and bright lines is of course purely fortuitous, as the values in either case may be many kilometers in error.

Star	Dark Lines		Bright Lines Compared with 132 *Schj.*		Mean
	V	No. Lines	V	No. Lines	V
132 *Schjellerup*.......	−28	..	....	..	−28
280 *Schjellerup*.......	−25	17	−25	16	−25
19 *Piscium*...........	− 2	24	− 2	13	− 2
318 *Birmingham*.....	− 8	15	−12	14	−10
74 *Schjellerup*.......	+ 3	13	+ 6	9	+ 5
78 *Schjellerup*........	− 1	14	− 1	13	− 1
115 *Schjellerup*.......	−11	9	−14	11	−13
152 *Schjellerup*.......	− 4	13	+ 6	16	+ 1

For a check on these results see the table on p. 118.

TABLE OF CORRECTIONS FOR RADIAL VELOCITY

The corrections to be applied to the measured wave-lengths of the star lines (after reduction to the Sun) to eliminate the displacements due to radial velocity are given in the following table. The displacements are given in hundredths of an Ångström unit.

V in km. / λ	1	2	5	10	13	25	28	V in km. / λ	1	2	5	10	13	25	28
4200	1	3	7	14	18	35	39	5100	2	3	9	17	22	43	48
4300	1	3	7	14	19	36	40	5200	2	3	9	17	23	43	49
4400	1	3	7	15	19	37	41	5300	2	4	9	18	23	44	50
4500	2	3	8	15	20	38	42	5400	2	4	10	18	23	45	50
4600	2	3	8	15	20	38	43	5500	2	4	10	18	24	46	51
4700	2	3	8	16	20	39	44	5600	2	4	10	19	24	47	52
4800	2	3	8	16	21	40	45	5700	2	4	10	19	25	48	53
4900	2	3	8	16	21	41	46	5800	2	4	10	19	25	48	54
5000	2	3	8	17	22	42	47								

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY

The following table contains the mean wave-lengths of the lines measured in each star, with the correction for radial velocity, and the final mean of all the wave-lengths of the same line measured in each star. The stars are arranged in the assumed order of development.

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
1	...	...	...	...	...	...	...	...	...	...	...	...
1a	...	...	...	...	...	...	...	...	...	...	...	...
2	...	...	...	10	w D	84.08	...	...	...	...	...	...
3	...	...	...	2-3	n D	90.33	...	nn D	90.03	...	...	...
4	...	...	...	...	...	...	...	...	...	...	...	...
5	...	...	...	6-7	w D	94.83	...	wn D	95.17	...	wn D	95.06
6	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
7	...	...	...	1	D	97.65	...	...	...	...	...	...
8	...	...	...	2	D	00.87	...	wn D	01.02	...	wn D	00.7
9	...	...	...	3	B	02.47	3-4	n B	02.47	2-3	n B	02.61
10	...	...	...	...	...	...	...	...	...	...	...	...
11	...	...	...	7	w D	04.98	2-3	wn D	05.15	...	nn D	05.1
12	...	...	...	3	D?	08.51	...	...	...	...	wn D	08.61
13	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
14	...	...	...	...	...	...	...	...	...	...	...	...
15	...	...	...	1	D?	12.29	...	...	...	...	...	...
16	...	...	...	...	...	...	...	B?	09.8	...	...	...
	...	...	...	...	...	...	...		14.2	...	...	...
17	...	...	...	3	n D	15.17	2-3	n D	15.11	...	nn D	15.3
18	...	...	...	...	...	...	...	...	...	...	...	...
19	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
20	...	...	...	2-3	wn D	20.60	...	...	...	...	...	...
21	...	...	...	...	B?	...	...	...	...	...	...	...
22	...	...	...	...	...	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...
24	...	...	...	...	...	...	1-2	n D	25.86	...	...	...
25	...	...	...	1	B	26.81	...	...	...	...	...	...
26	...	...	...	2	D	27.49	2-3	n D	27.96	3	nn D	27.8
27	...	nn D	4429.51	2-3	n D	30.18	1-2	n D	30.27	...	nn D	30.42
28	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	1	n D	33.96	...	...	...
30	...	...	...	...	...	...	...	B	31.0	...	...	...
	...	...	...	...	...	...	...		33.60	...	...	...
31	3	nn D	4435.22	5	w D	35.52	5	wn D	35.49	...	wn D	35.72
32	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
33	...	...	...	1	D	38.13	1-2	n D	38.23	...	...	...
34	...	...	...	2	B??	38.89	5-6	n B	39.10	...	...	...
35	...	B?	37.0	...	...	...	...	...	...	...	...	...
	...		39.9	...	...	...	...	...	...	...	...	...
36	...	...	...	2-3	n D	44.45	1-2	D	44.45	...	...	...
37	...	...	...	...	B??	...	...	...	...	...	...	...
38	...	...	...	...	...	...	...	B	45.0	...	...	...
	...	...	...	...	...	...	...		46.8	...	...	...
39	...	...	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...	...	...
41	...	...	...	1-2	n D??	47.14	2	n D	47.47	...	...	...
42	...	...	...	2-3	n B?	48.68	4	n B	48.61	5	n B	48.88
43	...	...	...	5	n D	49.96	...	wn D	50.04	...	nn D	50.35
44	...	...	...	...	...	...	...	...	...	...	...	...
45	...	...	...	2-3	n D	55.23	1	n D	55.35	...	nn D	55.8
46	...	...	...	...	...	...	...	...	...	...	...	...
47	...	...	...	...	...	...	...	...	...	...	...	...
48	...	...	...	...	...	...	...	...	...	...	...	...
49	...	...	...	...	...	...	...	...	...	...	nn D	60.01
	...	...	...	...	...	...	...	...	...	...		
50	...	...	...	3	n D	62.17	3	n D	62.07	...	nn D	62.48
51	...	nn B??	4463.76	3-4	w B	64.01	6	n B	63.91	...	w B	64.0

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY

78 Schjellerup			*132 Schjellerup*			*115 Schjellerup*			*152 Schjellerup*			Mean Wave-Length
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	....	.....	...	head	71.80	...	....	.....	...	....	.....	4371.8
...	....	.....	...	head	80.63	...	....	.....	...	....	.....	4380.6
...	....	.....	1	n D	85.20	...	....	.....	...	....	.....	4384.6
2	n D	89.82	1-2	n D	89.77	...	....	.....	...	....	.....	4390.0
...	....	.....	2	n D	91.95	...	....	.....	...	....	.....	4391.9
8	wn D	95.10	...	n D	95.1	...	....	.....	...	....	.....	4395.0
...	....	.....	...	con.	95.8	...	....	.....	...	....	.....	439
...	....	.....	...	spec.	97.9	...	....	.....	...	....	.....	
...	....	.....	1-2	n D	98.24	...	....	.....	...	....	.....	4397.9
8	wn D	01.14	1-2	wn D	00.89	...	....	.....	...	....	.....	4401.0
...	n B?	02.68	2	n B	02.47	...	....	.....	2-3	B??	02.70	4402.6
...	....	.....	4	D?	03.30	...	....	.....	...	....	.....	4403.3
...	nn D	05.21	1-2	wn D	05.24	...	nn D?	04.92	3	n D?	04.91	4405.1
3	nn D	08.75	1	wn D	08.52	1	n D?	07.90	...	....	.....	4408.5
...	....	.....	...	....	.....	...	....	.....	...	D	03.3	440
...	....	.....	...	....	.....	...	....	.....	...		09.6	
...	....	.....	...	n D??	11.20	...	....	.....	1	n D	10.58	4410.9
...	....	.....	1-5	nn D?	12.23	...	....	.....	1-2	n D	12.45	4412.3
...	....	.....	...	con.	12.7	...	....	.....	...	....	.....	......
...	....	.....	...	spec.	14.7	...	....	.....	...	....	.....	4418.5
3	nn D	15.18	1-3	n D	15.28	...	....	.....	3-4	n D	15.45	4415.2
...	....	.....	2	D?	16.71	...	....	.....	...	....	.....	4416.7
...	....	.....	...	con.	18.0	...	....	.....	...	....	.....	441
...	....	.....	...	spec.	20.3	...	....	.....	...	....	.....	
...	nn D	20.5	2	n D	20.60	...	....	.....	...	....	.....	4420.6
...	....	.....	2	n B?	21.18	...	....	.....	1	B?	20.81	4421.0
...	....	.....	2-3	D	21.70	...	....	.....	...	....	.....	4421.7
...	....	.....	3	n B?	23.99	...	....	.....	2	B??	23.88	4423.9
...	nn D	26.25	1-6	nn D?	25.86	...	....	.....	2	n D	25.80	4425.9
...	....	.....	6	B??	16.69	...	....	.....	...	....	.....	4426.8
1	nn D	27.63	1-6	n D	27.72	...	....	.....	2	n D	27.74	4427.7
1	nn D	30.37	1-2	n D	30.28	...	....	.....	2-3	n D	30.54	4430.2
...	....	.....	...	D	29.6	...	....	.....	...	....	.....	442
...	....	.....	...		30.9	...	....	.....	...	....	.....	
...	....	.....	1	n D?	33.92	...	....	.....	...	....	.....	4433.9
...	....	.....	...	con.	30.9	...	....	.....	...	....	.....	4431.0
...	....	.....	...	spec.	35.0	...	....	.....	...	....	.....	4434.3
6-7	wn D	35.92	3	wn D	35.60	4-5	wn D	35.47	6	wn D	35.97	4435.6
...	....	.....	...	D	35.0	...	....	.....	...	....	.....	443
...	....	.....	...		36.3	...	....	.....	...	....	.....	
1	nn D	38.14	1-7	n D	38.14	...	....	.....	1-2	n D	38.25	4438.2
2-3	n B	39.44	4	n B	38.86	3	n B?	38.71	...	B??	.....	4439.0
...	....	.....	...	....	.....	...	....	.....	...	....	.....	443
2	n D	44.58	1-6	n D	44.51	...	....	.....	1	n D	44.64	4444.5
...	....	.....	5	B?	45.16	...	....	.....	2	B	45.32	4445.2
...	....	.....	...	....	.....	...	....	.....	...	....	.....	444
...	....	.....	2	D??	45.68	...	....	.....	2	D	45.79	4445.7
...	....	.....	3	n B?	46.14	...	....	.....	1	n B??	46.37	4446.3
1	nn D	47.66	2	n D??	47.44	...	....	.....	2	n D?	47.57	4447.5
2-3	n B	48.88	8	n B	48.65	...	....	.....	...	....	.....	4448.7
3	n D	50.32	2-3	n D??	50.04	2-3	wn D	50.02	...	wn D??	50.3	4450.1
...	....	.....	5	B	54.23	...	....	.....	...	....	.....	4454.2
1-2	n D	55.52	1-3	D?	55.33	...	....	.....	1	n D	55.38	4455.4
...	....	.....	0-1	D?	56.76	...	....	.....	...	....	.....	4456.7
...	....	.....	...	....	.....	...	....	.....	1	n D	58.08	4458.1
...	....	.....	4	n B??	58.81	...	....	.....	1	B?	58.72	4458.8
...	....	.....	...	D?	59.3	...	....	.....	...	....	.....	445
...	....	.....	...		60.1	...	....	.....	...	....	.....	
2	n D	62.24	8	w D	62.10	...	n D?	62.2	4-5	n D	62.05	4462.2
3	n B	63.84	2-8	B	64.08	...	....	.....	2-7	n B	64.09	4464.0

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
52	...	...	...	...	...	...	...	...	...	...	B	63.1 64.80
53	4	wn D	4465.96	1	D?	65.29	1	n D	65.43	...	...	...
54	...	...	...	...	...	...	...	...	...	...	...	...
55	...	...	...	1-2	D	68.95	...	...	...	...	...	...
56	1	n D	4471.64	1	D??	72.25	1	nn D	71.72	...	...	...
57	...	...	...	...	...	...	...	...	...	...	...	...
58	...	...	...	...	B?	...	...	...	...	...	...	...
59	...	...	...	...	...	...	...	B	72.4	...	...	...
60	...	...	...	...	...	...	...	B	72.4 74.5	...	...	...
61	...	...	...	...	...	...	...	...	...	...	...	...
62	...	...	...	1-2	n D	75.52	1	n D	76.18	1	nn D	75.4
63	...	...	...	...	B?	...	...	B??	...	max	B	79.0
64	...	...	...	1-2	n D??	80.00	1	nn D	80.42	1	nn D?	80.22
65	1	nn D	4481.74	2-3	D	82.19	2-3	n D	82.41	1	nn D	82.34
66	...	...	...	2-3	n B	83.62	2	n B	83.64	...	...	...
67	...	...	...	...	...	...	...	...	...	...	...	...
68	...	...	...	2	B?	86.03	1-2	n B?	86.27	...	...	...
69	...	...	...	1-2	D	87.57	2	nn D	87.42	1-2	nn D	87.61
70	...	...	...	3	B?	88.61	...	...	...	...	...	...
71	1	n D	4489.35	2-3	D	89.75	3	n D	89.80	1	D	90.05
72	...	...	...	...	...	...	...	...	...	...	...	...
73	...	wn D	4496.73	4-5	D	97.02	...	wn D	96.97	2	n D	97.21
74	...	...	...	...	B??	98.0 01.1	...	...	...	...	...	...
75	...	nn D	4501.22	4	D	01.78	2-3	nn D	01.87	1-2	nn D	01.97
76	...	...	...	...	...	...	...	...	...	...	...	...
76a	...	head	...	...	head	02.3	...	head	02.6	...	head	02.5
77	...	...	...	...	...	...	...	B	02.5 06.3	...	B	02.5 06.3
78	2	n D	4506.38	6	D	06.77	2-3	n D	07.08	2-3	n D	07.04
79	...	...	...	...	B??	...	6	n B?	08.64	...	...	...
80	...	...	...	1	D?	09.77	1	n D	09.56	1	nn D	09.91
81	...	...	...	...	B??	...	4	B??	10.8	...	...	...
82	...	...	...	...	...	...	...	...	...	...	...	...
83	3?	nn D	4512.83	...	wn D	12.76	2	nn D	12.64	...	nn D	12.3
83a	...	...	...	...	head	14.3	...	...	...	...	...	...
84	...	...	...	1	D?	16.17	...	...	...	...	...	...
85	...	...	...	2	n B	17.05	max	B	17.71	...	...	...
86	1-2	n D	4518.15	3-4	D	18.27	3	n D	18.31	1-2	n D	18.38
87	...	...	...	1	D??	20.54	...	...	...	...	...	...
88	1-2	nn B	4521.15	3-4	B	21.66	3	wn B	21.67	8	wn B	21.91
89	...	...	...	...	...	...	...	...	...	...	...	...
90	1	n D	4522.91	4	D	23.00	4-5	D	23.06	1-2	nn D	23.20
91	...	...	...	...	B??	...	...	...	...	...	...	...
92	...	...	...	...	...	...	...	...	...	...	...	...
93	...	...	...	5	n D	27.16	...	...	...	0	nn D	27.40
94	...	...	...	...	...	...	1	nn D	28.65	...	...	...
95	...	...	...	2-3	D	31.35	1	nn D	31.43	1	nn D	30.96
95a	...	...	...	...	head	31.9	...	...	...	...	...	...
96	...	...	...	...	...	...	...	...	...	...	...	...
97	...	w D	4535.30	6	w D	35.84	...	nn D	35.81	...	nn D	35.90
98	...	D	4530.7 4535.8	...	...	...	...	D	... 36.6	...	...	...
99	...	w D	4537.98	3	B	37.32	3	wn B	37.38	...	...	...
100	...	...	...	2-3	B	39.00	2	n B?	38.89	...	...	...
101	...	...	...	...	...	...	...	B	36.5 39.7	...	B	36.6 39.9
102	1	n D	4539.89	2	D	40.42	4	n D	40.51	1-2	nn D	40.57
103	...	...	...	1	D??	42.75	...	...	...	...	...	...
104	...	...	...	2	B	44.10	...	...	...	...	...	...
105	...	...	...	...	...	...	...	...	...	...	...	...

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			Mean Wave-Length
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	B	62.9	...	B	63.0	...	....	.....	...	B	.....	4463.0
...		65.1	...		64.8	...	....	.....	...		64.6	4464.9
1	n D	65.37	1	n D??	65.76	...	....	.....	...	n D??	64.88	4465.4
...	....	.....	2	D	66.90	...	....	.....	...	....	.....	4466.9
1	n D	68.68	1	n D	69.02	...	....	.....	1	n D	68.48	4468.8
2	nn D	71.58	2	n D??	71.72	·1	D	70.85	1	n D??	71.81	4471.7
...	D	65.0	...	....	.....	...	....	.....	...	con.	64.6	4464.7
...		72.0	...	....	.....	...	....	.....	...	spec.	72.6	4472.0
...	....	.....	2	B.?	72.32	...	....	.....	1	n B??	72.57	4472.4
...	....	.....	4-5	B	73.55	...	....	.....	3	n B	73.56	4473.6
...	....	.....	...	B	73.0	...	....	.....	...	....	.....	4472.7
...	....	.....	...		75.0	...	....	.....	...	....	.....	4474.7
...	....	.....	1	n D	75.31	...	....	.....	...	....	.....	4475.3
1	n D	75.33	1	D	75.82	...	....	.....	...	....	.....	4475.6
...	....	.....	3	B	79.08	1	B?	78.58	...	wn B??	78.78	4478.8
1	nn D?	80.21	2–3	n D??	80.13	...	....	.....	2	n D??	79.96	4480.2
2	n D	82.23	2-5	D	82.50	...	....	.....	2	n D	82.43	4482.3
...	....	.....	1	B??	83.46	2	nn B??	84.13	...	....	.....	4483.7
...	....	.....	.....	con.	83.0	...	....	.....	...	B?	82.9	448
...	....	.....	.....	spec.	86.	...	....	.....	...		87.8	
...	....	.....	5	n B??	86.15	2	n B??	85.87	...	....	.....	4486.1
1	nn D	87.62	1-3	n D	87.33	...	....	.....	1	nn D?	87.28	4487.5
...	....	.....	1-5	B??	88.70	...	....	.....	1	B?	88.84	4488.7
2-3	n D	89.86	2-3	n D	89.77	...	....	.....	3	nn D	89.61	4489.7
...	....	.....	...	con.	90.4	...	....	.....	...	B?	90.4	4490.4
...	....	.....	...	spec.	96.2	...	....	.....	...		.....	4496.
3–4	n D	96.97	6–8	w D	96.99	1-2	n D	97.04	...	....	.....	4497.0
...	....	.....	...	con.	98.0	...	....	.....	...	....	.....	4498.0
...	....	.....	...	spec.	01.3	...	....	.....	...	....	.....	4501.2
1	nn D	01.87	1-8	w D	01.92	1	nn D	00.91	1	n D	02.15	4501.7
...	....	.....	3	B??	03.14	1	n B?	03.91	2–3	nn B??	03.79	4503.6
...	head	02.7	...	head	02.71	...	....	.....	...	....	.....	4502.8
...	B	02.7	...	B	02.4	...	....	.....	...	....	.....	4502.5
...		06.2	...		06.0	...	....	.....	...	....	.....	4506.2
3–4	wn D	07.09	2	wn D	07.12	2	n D	06.74	2	nn D	07.24	4506.9
4	wn B	08.71	max	B??	08.65	3	n B	08.21	...	B??	.....	4508.6
1	nn D	09.84	1–3	n D??	09.89	...	....	.....	3	n D??	09.96	4509.8
...	....	.....	3	n B??	10.66	...	....	.....	...	....	.....	4510.7
...	B	08.30	...	B	08.3	...	....	.....	...	....	.....	4508.3
...		11.60	...		09.5	...	....	.....	...	....	.....	......
...	wn D	13.08	2	wn D	12.83	1-2	nn D	13.05	1	nn D	12.81	4512.8
...	....	.....	...	head	15.15	...	....	.....	...	....	.....	4514.7
...	....	.....	1	n D	16.34	...	....	.....	1	nn D?	16.02	4516.2
1–2	n B	17.13	4	n B??	17.31	...	....	.....	1	B??	17.20	4517.3
2–3	n D	18.53	1–3	n D	18.35	1-2	n D	18.21	1-2	wn D?	18.23	4518.3
...	....	.....	1	n D??	20.71	...	....	.....	1	nn D??	20.16	4520.5
4	B	21.89	3	B??	21.75	...	....	.....	...	B??	.....	4521.7
...	....	.....	...	B	20.9	...	....	.....	...	....	.....	452
...	....	.....	...		22.4	...	....	.....	...	....	.....	
4	n D	23.23	4–6	w D	23.17	2–3	n D	23.08	5	n D	23.21	4523.1
3–4	n B	25.01	3	B??	24.68	3	n B??	24.59	2-5	B?	24.63	4524.7
...	B	24.1	...	B	23.9	...	....	.....	...	....	.....	4524.0
...		26.0	...		27.3	...	....	.....	...	....	.....	4527.
...	wn D	27.56	1	n D?	27.2	...	n D?	27.48	...	....	.....	4527.4
...	....	.....	3	D	28.69	...	....	.....	...	....	.....	4528.7
1	n D?	31.32	1	n D	31.29	...	....	.....	...	....	.....	4531.3
...	....	.....	...	head	32.73	...	....	.....	...	....	.....	4532.3
...	....	.....	3	n D	33.44	...	....	.....	...	....	.....	4533.4
2-3	n D	35.70	6–8	wn D?	36.04	...	n D	35.56	1–2	n D	36.21	4535.7
...	D	31.1	...	....	.....	...	....	.....	...	....	.....	4530.9
...		36.7	...	....	.....	...	....	.....	...	....	.....	4536.3
2	n B?	37.32	2-3	n B?	37.45	..	n B?	37.08	2-4	n B	37.68	4537.5
2-3	B	39.18	3-6	n B??	39.00	1	B	38.66	4-5	B	39.16	4539.0
...	....	.....	...	B	36.6	...	....	.....	...	B	37.2	4536.7
...	....	.....	...		40.0	...	....	.....	...		40.2	4540.0
3	n D	40.66	3	wn D?	40.46	...	....	.....	1	n D	40.44	4540.4
...	....	.....	2	n D??	42.51	...	....	.....	2-3	wn D??	43.06	4542.8
1	B	44.25	...	max B??	44.40	...	....	.....	1	n B?	44.10	4544.2
...	....	.....	2	n D	44.92	...	....	.....	...	....	.....	4544.9

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
106	...	....	....	3	B	47.79	4	n B?	47.71	max	B	47.56
107	... ...	....	....	... ...	....	....	... ...	....	....	... ...	B	46.8 48.5
108	...	....	....	5	wn D	49.25	...	wn D	49.37	...	....	.....
109	... ...	....	....	... ...	....	....	... ...	....	....	... ...	....	....
110	... ...	....	....	... ...	....	....	... ...	....	....	... ...	....	....
111	...	....	....	...	....	.....	...	....	.....	...	....	.....
112	9	w D	4553.58	10	w D	53.54	...	wn D	53.58	...	wn D	54.07
113	... ...	....	....	... ...	D	51.8 54.7	... ...	D	52.3 55.3	... ...	....	....
113a	...	....	....	...	head	54.70	...	head	55.3	...	....	.....
114	...	....	....	...	....	.....	...	....	.....	max	B	58.40
115	... ...	B	4555.5 4559.3	... ...	B	55.3 59.3	... ...	B	55.3 59.4	... ...	B	55.40 59.90
116	...	nn D?	4560.11	3	n D	60.39	5	nn D	60.42	...	nn D	60.48
117	...	....	....	3	n B	61.91	...	....	.....	...	....	.....
118	1	D	4562.93	2-3	D??	63.35	3	D	63.54	...	nn D	63.47
119	...	....	....	...	B??	.....	...	....	.....	...	....	.....
120	0-1	D	4565.22	1-2	D??	65.73	1-2	D	65.71	1	n D	65.74
121	...	....	....	...	....	.....	...	....	.....	...	....	.....
122	...	....	....	...	....	.....	...	....	.....	...	....	.....
123	... ...	B	4565.90 4569.50	... ...	B	66.3 70.0	... ...	B	66.2 70.5	... ...	....	....
124	...	....	....	...	....	.....	...	....	.....	...	....	.....
125	...	nn D	4571.57	9	w D??	71.66	...	wn D	71.79	...	nn D	71.30
126	...	....	....	...	....	.....	...	....	.....	...	....	.....
127	...	....	....	3	n D	75.27	...	nn D?	75.10	...	....	.....
128	...	....	....	3-4	n D	77.57	1	nn D	77.47	...	n D	77.60
129	... ...	....	....	... ...	....	....	... ...	D	70.9 76.9	... ...	....	....
129a	...	....	....	...	head	78.1	...	head	77.0	...	....	.....
130	...	....	....	...	....	.....	...	....	.....	...	....	.....
131	...	....	....	...	....	.....	...	....	.....	...	....	.....
132	...	....	....	...	....	.....	...	....	.....	...	....	.....
133	...	....	....	1	D	80.42	1	nn D	80.52	...	....	.....
134	...	....	....	...	....	.....	...	....	.....	...	....	.....
135	...	....	....	1	D??	81.93	1	nn D	82.57	...	....	.....
136	5-6	wn B	4583.59	2	n B	83.67	...	....	.....	...	....	.....
137	...	....	....	1-2	D	84.57	1	n D	84.82	...	....	.....
138	...	....	....	1	B?	85.41	...	....	.....	...	....	.....
139	2	n D	4586.38	2	n D	86.37	1	nn D?	86.10	...	....	.....
140	...	....	....	...	....	.....	...	....	.....	...	....	.....
141	...	....	....	...	....	.....	...	....	.....	...	....	.....
142	...	....	....	...	....	.....	...	....	.....	...	....	.....
143	...	....	....	...	....	.....	...	....	.....	...	....	.....
144	...	....	....	1	D?	91.01	1-2	nn D	91.26	...	....	.....
145	... ...	....	....	... ...	....	....	... ...	....	....	... ...	....	....
146	1	n D	4594.19	2-3	n D	91.34	2	nn D	94.30	...	nn D	94.69
147	2	nn B?	4596.11	2	n B	95.80	5	n B	96.10	4	n B	96.15
149	... ...	....	....	... ...	....	....	... ...	....	....	... ...	....	....
150	...	....	....	1	n D??	97.52	2	n D	97.61	...	....	.....
151	1	n B?	4599.58	...	....	.....	...	....	.....	...	....	.....
152	...	....	....	1-2	n D	00.84	3	n D	00.61	1	n D	00.87
153	...	....	....	...	....	.....	...	....	.....	...	....	.....
154	...	....	....	...	....	.....	...	....	.....	...	....	.....
155	...	....	....	...	....	.....	...	....	.....	...	....	.....
156	7-8	D	4606.26	9	w D	06.87	10	w D	06.86	8	w D	06.88
157	...	....	....	...	....	.....	...	....	.....	...	....	.....
158	...	head	4607.5	...	head	07.9	head	....	08.3	...	....	.....
159	... ...	....	....	... ...	....	....	... ...	D	05.7 08.3	... ...	....	....
160	3	n B	4608.47	2-3	n B	08.71	2	n B?	09.19	5	n B??	08.90
161	... ...	B	4607.5 4615.0	... ...	....	....	... ...	B	08.3 13.4	... ...	....	....
162	...	....	....	1	n D??	10.07	1	nn D?	10.57	1	n D	10.56

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			Mean Wave-Length
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	
2–3	n B	47.75	4–6	B	47.63	1	B	47.81	4	n B	47.73	4547.7
...	....	.....	...	....	.....	...	....	.....	...	....	.....	{ 454
...	....	.....	...	....	48.8	...	....	.....	...	....	.....	
3	wn D	49.25	1	nn D?	49.47	...	....	.....	5–6	n D	49.27	4549.3
...	....	.....	...	D	{ 48.8	...	....	.....	...	....	.....	{ 454
...	....	.....	...		{ 50.1	...	....	.....	...	....	.....	
...	....	.....	...	B	{ 50.0	...	....	.....	...	....	.....	{ 455
...	....	.....	...		{ 52.3	...	....	.....	...	....	.....	
...	....	.....	...	nn D?	52.85	...	....	.....	...	wn D	52.65	4552.8
7	wn D	53.79	4	w D	54.21	4	n D	54.09	...	....	.....	4553.8
...	D	{	...	D	{ 52.1	...	....	.....	...	....	.....	4552.0
...		{ 55.3	...		{ 55.4	...	....	.....	...	....	.....	4555.1
...	....	.....	...	head	54.68	...	....	.....	...	....	.....	4554.9
...	....	.....	3–4	nn B??	58.88	...	....	.....	1	n B??	58.85	4558.7
...	B	{ 55.3	...	B	{ 55.3	...	....	.....	...	....	.....	4555.3
...		{ 59.7	...		{ 59.6	...	....	.....	...	....	.....	4559.5
4	n D	60.47	...	nn D??	60.23	...	nn D?	60.35	2	n D	60.21	4560.3
3–4	n B	62.10	1–3	B??	62.25	...	....	.....	1	n B??	62.27	4562.1
3	n D	63.51	2	n D	63.45	2	n D	63.56	...	....	.....	4563.5
2	n B??	64.71	2	n B??	64.57	...	....	.....	3	n B	64.68	4564.7
1	nn D	65.61	1	wn D??	65.95	5	n D	65.85	...	D?	.....	4565.8
...	....	.....	...	....	.....	...	....	.....	2–3	wn B	67.72	4567.7
...	....	.....	2–3	B??	69.46	...	....	.....	...	....	.....	4569.5
...	B	{ 66.3	...	B	{ 64.0	...	B	{ 66.8	...	....	.....	4566.3
...		{ 70.3	...		{ 70.0	...		{ 69.4	...	....	.....	4569.8
...	....	.....	...	....	.....	...	....	.....	2	B	70.31	4570.3
...	n D	72.55	...	....	.....	...	....	.....	...	....	.....	4571.8
...	....	.....	2	B?	73.71	...	....	.....	...	....	.....	4573.7
...	....	.....	1	n D?	75.78	...	....	.....	...	....	.....	4575.4
1	n D?	77.26	1	n D?	77.61	...	....	.....	2	D	77.67	4577.5
...	D	{ 70.3	...	....	.....	...	D	{ 73.8	...	D	{ 70.9	4574.2
...		{ 78.1	...	....	.....	...		{ 77.2	...		{ 78.4	4577.7
...	head	78.1	...	head	78.05	...	head	77.2	...	....	.....	4577.6
...	....	.....	4	B	78.52	...	....	.....	1–2	B?	78.56	4578.5
2	nn B?	79.37	...	....	.....	...	....	.....	2	n B	78.96	4579.2
...	....	.....	4	B	79.69	...	....	.....	1–2	B	79.67	4579.7
1–2	nn D	80.47	1–4	n D	80.38	...	....	.....	1–3	n D	80.50	4580.5
1	n B	81.68	4	B	81.20	...	....	.....	1–2	nn B?	81.19	4581.4
1–2	nn D	82.51	1	n D??	82.85	...	....	.....	...	n D	82.94	4582.6
2–3	n B	83.93	5	B	83.92	...	....	.....	1	B?	83.86	4583.8
...	....	.....	3	D	84.72	...	....	.....	...	n D?	84.72	4584.7
1	B	85.62	5	B	85.50	...	....	.....	...	....	.....	4585.5
1	n D	86.76	3	D	86.28	...	....	.....	2	D	86.37	4586.4
...	....	.....	2	B	86.89	...	....	.....	...	....	.....	4586.9
...	....	...:	2	D?	87.43	...	....	.....	...	....	.....	4587.4
...	....	.....	...	B??	.....	...	....	.....	2	B	89.07	4589.1
max	B	89.85	3–4	B?	90.39	...	....	.....	2	B?	90.54	4590.3
1	n D	91.39	4	n D	91.10	1	n D?	91.14	2	D	91.25	4591.2
...	....	.....	...	....	.....	...	....	.....	...	B	{ 89.9	{ 459
...	....	.....	...	....	.....	...	....	.....	...		{ 93.2	
...	....	.....	3	D	94.10	...	....	.....	1–5	n D	93.93	4594.3
4	n B	96.04	4–6	nn B?	96.08	...	....	.....	max	B	(95.42)	4596.0
...	....	.....	...	....	.....	...	....	.....	...	B	{ 94.6	{ 459
...	....	.....	...	....	.....	...	....	.....	...		{ 95.9	
1	nn D?	97.32	1	wn D?	97.33	0–1	n D	97.34	1–2	nn D??	97.37	4597.4
1	n B?	99.33	3–4	n B?	99.53	...	....	.....	max	B??	99.22	4599.5
2	n B	01.00	4	D	01.00	1	nn D	00.68	1	n D	00.89	4600.8
...	....	.....	4	B	02.01	...	....	.....	1	n B??	02.27	4602.1
...	....	.....	2	D	02.95	...	....	.....	...	nn D?	02.83	4602.9
...	....	.....	1	n D	06.23	...	....	.....	...	....	.....	4606.2
3-4	n D	07.20	...	w D	06.83	2–3	n D	06.24	...	wn D	06.37	4606.7
...	....	.....	4	n D	07.50	...	....	.....	...	....	.....	4607.5
...	head	08.2	...	head	08.01	...	head	08.5	...	....	.....	4608.1
...	D	{ 02.9	...	D	{ 03.0	...	n D	{ 05.4	...	....	.....	4605.6
...		{ 08.3	...		{ 08.5	...		{ 08.5	...	....	.....	4608.4
2	n B?	09.17	...	B??	.....	...	....	.....	...	n D?	08.92	4608.9
...	B	{ 08.4	...	B	{ 08.2	...	....	.....	...	....	.....	4608.1
...		{ 13.3	...		{ 09.9	...	....	.....	...	....	.....	......
1	n D	10.22	2	D	10.17	...	....	.....	...	....	.....	4610.3

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
163	...	....	....	...	D??	.....	...	....	.....	...	....	.....
164	...	....	....	1–2	B??	12.32	1	n B??	12.39	...	....	.....
165	...	....	....	1–2	n D	13.80	2–3	n D	13.73	2	n D	13.77
166	...	....	....	3	B	14.95	5–6	n B	15.15	6	n B	15.03
167	1	n D	4616.06	2–3	D	16.29	3–4	n D	16.46	3	n D	16.31
168	...	....	....	...	....	.....	...	....	.....	...	....	.....
169	4	B	4617.74	6	B	17.80	7–8	n B	18.03	9	w B	17.99
170	1	n D	4619.29	5	D?	19.68	6	D	19.86	3	n D	19.70
171	...	....	....	4	B	21.35	5	n B	21.56	5	n B	21.58
172	...	....	....	1–2	n D??	22.81	2–3	nn D	23.05	1–2	nn D	23.09
173	...	....	....	...	....	.....	...	....	.....	...	....	.....
174	...	....	....	...	....	.....	...	....	.....	...	....	.....
175	...	....	....	...	....	.....	...	....	.....	...	....	.....
176	... ...	....	....	... ...	....	....	... ...	....	....	... ...	B	23.6 27.9
177	...	....	....	...	D??	.....	...	....	.....	...	....	.....
178	...	....	....	5	wn D	29.26	8	n D	29.54	6–8	nn D	29.12
179	...	....	....	...	....	.....	...	....	.....	...	....	.....
180	4	n B	4630.97	4	B	31.15	2	n B?	31.34	9	n B	31.18
181	...	....	....	...	....	.....	...	....	.....	...	....	.....
182	...	....	....	1	D	31.61	...	....	.....	1	nn D	34.6
183	...	....	....	2	D	37.46	1	nn D	37.41	...	....	.....
184	2	n B?	4638.03	3	B	38.75	3–4	n B	39.19	6	n B	39.03
185	3	n D	4639.86	5–6	D	40.29	6	D	40.46	5	D	40.76
186	... ...	....	....	... ...	....	....	... ...	....	....	... ...	....	....
187	1–2	n B	4642.10	3–4	B	41.72	4	wn B	42.16	8–9	w B	42.31
188	...	....	....	...	B??	.....	...	....	.....	...	....	.....
189	... ...	B	4640.6 4644.4	... ...	....	....	... ...	B	41.3 44.1	... ...	B	41.1 43.2
190	4	D	4646.05	...	wn D	45.70	...	....	.....	...	wn D	46.30
191	...	....	....	2–3	n B??	52.80	...	....	.....	1	nn B??	53.05
192	...	....	....	1	D?	51.04	...	....	.....	...	....	.....
193	...	nn D	4655.25	1	D	56.6	...	....	.....	...	wn D	56.30
194	2–3	n B	4660.48	...	w B	60.91	...	....	.....	...	....	.....
195	... ...	B	4657.5 4662.2	... ...	....	....	... ...	....	....	... ...	....	....
196	1	D?	4663.92	1–2	n D	64.14	...	....	.....	...	....	.....
197	1	n B?	4665.21	2	n B	65.41	...	....	.....	1–2	n B	65.24
198	4	n D	4668.15	3	wn D	68.08	...	....	.....	...	....	.....
199	2	n D	4674.79	4	D	75.13	...	....	.....	...	....	.....
200	...	wn D	4682.16	1	D?	82.29	...	....	.....	...	....	.....
201	...	....	....	1	n D??	88.43	...	....	.....	...	....	.....
202	...	....	....	1	n D?	91.12	...	....	.....	...	....	.....
203	...	....	....	3–4	n D	96.56	...	....	.....	...	....	.....
203a	...	....	....	...	head	97.2	...	....	.....	...	....	.....
204	...	....	....	...	D??	.....	...	....	.....	...	....	.....
205	...	....	....	...	....	.....	...	....	.....	...	....	.....
206	...	....	....	...	....	.....	...	....	.....	...	....	.....
207	5	n D	4714.49	6	w D	14.61	...	....	.....	...	wn D	15.00
208	...	....	....	...	....	.....	...	....	.....	...	....	.....
209	... ...	....	....	... ...	....	....	... ...	....	....	... ...	D	13.0 16.4
209a	...	....	....	...	head	14.8	...	....	.....	...	head	16.4
210	...	....	....	...	B??	.....	...	....	.....	...	....	.....
211	...	....	....	...	B??	.....	...	....	.....	...	....	.....
212	...	....	....	...	....	.....	...	....	.....	1–2	n B??	20.38
213	... ...	....	....	... ...	....	....	... ...	....	....	... ...	B?	16.4 21.3
214	...	....	....	1–2	n D	22.69	...	....	.....	1	n D	22.85
215	... ...	....	....	... ...	....	....	... ...	....	....	... ...	....	....
216	...	nn D	4728.61	...	....	.....	...	....	.....	1	nn D	28.5
217	...	....	....	...	....	.....	...	....	.....	...	....	.....
218	...	....	....	...	....	.....	...	....	.....	...	....	.....
219	...	....	....	10	w D	36.26	10	w D	36.3	10	w D	36.21
220	... ...	D	4733.5 4737.6	... ...	....	....	... ...	D	31.3 37.9	... ...	D	34.3 37.6
221	...	head	4737.6	...	head	37.61	...	head	37.9	...	head	37.6

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 Schjellerup			*132 Schjellerup*			*115 Schjellerup*			*152 Schjellerup*			Mean Wave-Length
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	....	.....	2	D??	11.32	...	....	.....	2	D??	11.42	4611.4
1	n B?	12.31	2	n B??	12.49	...	....	.....	2	B??	12.23	4612.3
2	n D	13.98	3–4	nn D	13.89	1–2	n D	13.91	1–3	n D	13.93	4613.9
6	B	15.21	4–9	n B	15.23	...	....	.....	2	B	15.14	4615.1
3	D	16.56	2–5	n D	16.36	3–8	w D	16.42	...	....	.....	4616.4
...	....	.....	1–2	B??	17.16	...	....	.....	...	B??	.....	4617.2
6–7	B	18.09	6–8	B	18.23	3	n B	17.74	4–8	B	18.15	4618.0
6	D	19.85	2	n D	19.56	1–2	n D	19.42	3–4	D	19.40	4619.6
5	B	21.51	2–6	n B??	21.51	...	....	.....	...	B??	.....	4621.5
2–3	n D	22.99	2	n D??	23.26	...	....	.....	1–2	n D??	22.47	4622.9
...	....	.....	4–5	B	24.18	...	....	.....	...	B??	.....	4624.2
...	....	.....	1–2	B	25.87	...	....	.....	...	....	.....	4625.9
...	n B?	27.9	2	B??	27.10	...	....	.....	...	....	.....	4627.1
...	....	.....	...	....	.....	...	....	.....	...	....	.....	} 462
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
...	....	.....	1	n D??	28.66	...	....	.....	...	....	.....	4628.7
...	wn D	29.84	2	n D?	30.08	...	....	.....	...	....	.....	4629.6
...	....	.....	1	n B?	30.98	...	....	.....	...	....	.....	4631.0
...	....	.....	1	B??	31.60	...	....	.....	...	....	.....	4631.2
...	....	.....	2	n B?	31.68	...	....	.....	...	....	.....	4631.7
...	....	.....	1	D	34.14	...	....	.....	...	....	.....	4634.4
...	....	.....	1	n D?	37.60	...	....	.....	1	n D	38.07	4637.6
4–5	B	39.15	5–8	B	39.07	1–2	n B	38.78	1–4	n B	38.96	4638.9
5	D	40.60	4	D	40.59	1–2	nn D	40.37	5	wn D	40.55	4640.4
...	....	.....	...	D	{ 39.5	...	....	.....	...	....	.....	} 464
...	....	.....	...		41.5	...	....	.....	...	....	.....	
3	n B	42.10	5–6	B	41.90	...	....	.....	...	B??	.....	4642.1
...	....	.....	3	B	43.33	...	....	.....	...	B??	.....	4643.3
...	....	.....	...	....	.....	...	....	.....	...	....	.....	4641.0
...	....	.....	...	....	.....	...	....	.....	...	....	.....	4643.9
...	n D	46.55	...	nn D?	46.86	...	....	.....	...	....	.....	4646.3
...	....	.....	4	B??	53.08	...	....	.....	...	....	.....	4653.0
...	....	.....	4	D	54.06	...	....	.....	...	....	.....	4654.0
1	n D	56.33	5	D	56.47	...	....	.....	...	....	.....	4656.4
...	....	.....	...	n B??	60.42	...	....	.....	...	B??	.....	4660.6
...	....	.....	...	....	.....	...	....	.....	...	....	.....	} 465
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
...	....	.....	1–3	n D?	64.21	...	....	.....	...	....	.....	4664.1
...	n B?	65.44	3–4	B	65.26	...	....	.....	...	....	.....	4665.3
1	n D	68.60	2–3	n D	67.87	...	nn D?	67.73	...	....	.....	4668.1
...	....	.....	...	D??	.....	1–2	n D	74.92	...	....	.....	4674.9
...	....	.....	2	n D?	82.55	...	....	.....	...	....	.....	4682.3
...	....	.....	...	nn D??	88.78	...	....	.....	...	....	.....	4688.6
...	....	.....	...	D??	.....	...	....	.....	...	....	.....	4691.1
...	....	.....	...	D??	.....	1	n D?	97.41	...	....	.....	4697.0
...	....	.....	...	....	.....	...	....	.....	...	....	.....	4697.2
...	....	.....	1	n D??	01.98	...	....	.....	...	....	.....	4702.0
...	....	.....	1	n D	03.82	...	....	.....	...	....	.....	4703.8
...	....	.....	1–3	B	09.75	...	....	.....	...	....	.....	4709.8
1	nn D	14.97	...	D??	.....	...	....	.....	...	....	.....	4714.7
...	....	.....	...	wn D??	15.55	...	....	.....	...	....	.....	4715.6
...	....	.....	...	....	.....	...	....	.....	...	....	.....	} 471
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
...	head	15.8	...	head	16.11	...	....	.....	...	....	.....	4716.1
max	B?	17.0	3	B	16.75	...	....	.....	...	....	.....	4716.8
...	....	.....	2	B??	18.13	...	....	.....	...	....	.....	4718.1
...	....	.....	2–3	B??	20.59	...	....	.....	...	....	.....	4720.5
...	con.	{ 16.3	...	....	.....	...	....	.....	...	....	.....	4716.4
...	spec.	21.3	...	....	.....	...	....	.....	...	....	.....	4721.3
...	n D	22.69	2–3	n D	22.67	0–1	D	22.29	...	....	.....	4722.6
...	....	.....	...	con.	{ 23.40	...	....	.....	...	....	.....	} 472
...	....	.....	...	spec.	27.70	...	....	.....	...	....	.....	
...	....	.....	...	D?	.....	1	D	29.71	...	....	.....	4729.2
...	....	.....	2	n B	31.63	...	....	.....	...	....	.....	4731.6
...	....	.....	1	n D??	32.51	...	....	.....	...	....	.....	4732.5
10	w D	36.43	10	w D	36.43	...	nn D	35.09	...	n D	36.6	4736.2
...	D	{ 34.	...	D	{	...	....	.....	...	....	.....	4734.0
...		38.	...		37.8	...	....	.....	...	....	.....	4737.7
...	head	37.7	...	head	37.61	...	....	.....	...	head	38.4	4737.7

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
222	4	n B	4739.10	8	B	38.62	5	n B	38.79	10	n B	38.69
223	...	....	....	1	D??	39.85	1	n D	40.14	...	....	.....
224	...	....	....	...	....	.....	...	....	.....	...	....	.....
225	...	B	1737.6 4741.2	...	....	.....	...	B	37.9 41.7	...	B??	39.6 42.1
226	10	n D	4743.40	7-8	w D	43.94	10	w D	43.94	...	wn D	43.84
227	...	D	4741.2 4745.2	...	....	.....	...	D	41.7 45.6	...	D	42.3 45.6
228	...	head	4745.37	...	....	.....	...	head	45.69	...	head	45.63
229	...	n B	4746.99	6-7	B	46.52	4	w B	46.77	...	....	.....
230	...	....	....	...	....	.....	...	....	.....	...	....	.....
231	...	B	4745.2 4748.8	...	....	.....	...	B	45.8 48.7	...	B	45.6 48.6
232	...	....	....	2	n D	49.62	...	nn D	49.50	...	nn D	49.2
233	...	....	....	...	....	.....	...	....	.....	...	....	.....
234	...	....	....	...	D??	.....	...	....	.....	...	....	.....
235	...	....	....	...	....	.....	...	....	.....	...	....	.....
236	...	wn B	4755.71	3	B	55.07	...	....	.....	...	B	55.5
237	...	....	....	1	D?	56.23	...	....	.....	...	....	.....
238	...	....	....	2	B	56.94	...	....	.....	...	....	.....
239	...	....	....	...	....	.....	...	....	.....	...	B	53.3 57.7
240	4-5	n D	4758.99	3	n D	58.41	4	n D	58.62	3-4	nn D	58.83
241	...	....	....	...	B??	.....	...	....	.....	...	....	.....
242	...	....	....	...	B??	.....	...	....	.....	...	....	.....
243	...	....	....	...	....	.....	...	....	.....	...	B	60.1 65.8
244	1	n D?	4766.78	1	D	66.11	...	nn D	66.47	...	nn D?	66.33
245	...	....	....	...	B??	.....	...	....	.....	...	....	.....
246	...	....	....	...	B??	.....	...	....	.....	...	....	.....
247	...	....	....	...	....	.....	...	....	.....	...	B	67.1 72.1
248	...	....	....	1-2	n D	72.40	2-3	nn D	73.01	...	nn D	73.15
249	...	....	....	...	B?	.....	...	....	.....	...	....	.....
250	...	....	....	...	....	.....	...	....	.....	...	....	.....
251	...	....	....	...	....	.....	...	....	.....	...	B	73.9 78.2
252	...	wn D	4783.1	2	n D	84.17	...	....	.....	1-2	nn D	84.43
253	...	....	....	...	....	.....	...	....	.....	2	n D	89.26
254	...	....	....	...	....	.....	...	....	.....	...	....	.....
255	...	....	....	...	....	.....	...	....	.....	...	B	90.1 96.3
256	...	....	....	...	....	.....	...	....	.....	8	n B?	02.44
257	...	....	....	...	....	.....	...	....	.....	...	....	.....
258	...	....	....	...	....	.....	2	n B?	10.54	...	....	.....
259	...	....	....	...	...	.....	...	nn D	12.03	...	n D?	12.1
260	...	....	....	...	B?	.....	2	n B?	13.98	4	n B??	13.99
261	2	n D	4815.44	2	n D	15.80	3-4	n D	15.62	1	wn D	16.01
262	...	nn B?	4818.26	...	....	.....	...	....	.....	...	B	18.0 22.9
263	...	nn D?	4822.75	1-2	n D?	23.91	3	n D	23.86	...	wn D	23.51
264	2	n B?	4824.94	...	B??	.....	...	....	.....	4-5	wn B??	25.97
265	...	....	....	...	....	.....	...	....	.....	...	....	.....
266	1	n D	4826.52	1-2	n D	27.81	3	n D	28.21	...	wn D	28.23
267	...	....	....	...	....	.....	3	n B	30.46	6	n B	30.36
268	2	n D	4832.49	1-2	n D	32.51	4-5	n D	32.56	5	n D	32.57
269	...	....	....	1	n D	36.30	...	....	.....	...	n D	36.2
270	...	nn D?	4839.78	1	n D	39.19	...	....	.....	...	wn D	39.50
271	...	....	....	1	D	43.49	1	D	43.62	1	nn D?	42.9
272	...	....	....	...	....	.....	...	....	.....	...	....	.....
273	...	....	....	...	....	.....	...	....	.....	...	....	.....
274	...	....	....	...	....	.....	...	....	.....	...	....	.....
275	...	....	....	1	n D	55.34	...	nn D	55.47	1	n D	55.64
276	...	nn B?	4857.42	...	B??	.....	1	n B?	57.68	3	n B	57.68
277	...	....	....	1	n D	59.46	...	....	.....	...	....	.....
278	9	B	4861.38	...	....	.....	...	....	.....	...	....	.....

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			MEAN WAVE-LENGTH
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m			t.m.			t.m.			t.m.	t.m.
5	B	38.95	5–7	B	38.79	3–4	B	38.92	...	B??	39.50	4738.9
...	....	.....	...	n D??	39.84	1	n D	40.19	...	....	.....	4740.0
...	....	.....	4–5	n B	41.08	...	....	.....	...	....	.....	4741.1
...	con.	37.8	...	B	37.8	...	....	.....	...	B	38.4	4737.7
...	spec.	42.2	...		42.6	...	....	.....	...		41.1	4741.8
10	w D	44.01	10	w D	44.00	10	w D	43.67	...	....	.....	4743.8
...	D	42.2	...	....	.....	...	....	.....	...	D	41.1	4741.7
...		45.4	...	....	.....	...	....	.....	...		45.5	4745.7
...	head	45.43	...	head	45.21	...	head	45.43	...	head	45.5	4745.5
max	B	46.72	7	n B	46.38	4–5	B	46.70	max	B	47.05	4746.7
...	....	.....	6	n B	48.32	...	....	.....	...	....	.....	4748.3
...	B	45.8	...	....	.....	...	....	.....	...	B	45.5	4745.5
...		(57.9)	...	....	.....	...	....	.....	...		49.3	4748.9
1	n D	49.90	2–3	n D??	49.40	...	nn D?	49.49	...	....	.....	4749.5
...	....	.....	4	n B	50.43	...	....	.....	...	....	.....	4750.4
...	....	.....	...	D??	.....	...	....	.....	10	w D	51.59	4751.6
...	....	.....	...	....	.....	...	....	.....	...	head	53.06	4753.0
...	....	.....	5	n B?	55.16	...	nn B?	55.11	2	n B	55.07	4755.3
...	....	.....	...	n D??	56.06	...	....	.....	...	n D??	56.11	4756.1
...	....	.....	3	n B?	56.93	...	nn B?	56.40	4	B	57.04	4756.8
...	B	45.3	...	....	.....	...	....	.....	...	....	.....	4753.
...		58.3	...	....	.....	...	....	.....	...	....	.....	4758.0
2–3	n D	59.00	...	D?	.....	...	wn D	58.90	3	n D	59.34	4758.9
...	....	.....	3	n B??	60.07	...	....	.....	2–4	n B	60.80	4760.4
...	....	.....	...	n B??	62.93	...	....	.....	3	B	63.37	4763.2
...	....	.....	...	....	.....	...	....	.....	...	....	.....	476
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
1	n D	66.55	...	nn D??	66.47	...	nn D	66.98	2	n D	66.54	4766.5
...	....	.....	...	....	.....	...	....	.....	2	n B?	67.94	4767.9
...	....	.....	...	....	.....	...	....	.....	1	n B?	69.58	4769.6
...	....	.....	...	....	.....	...	....	.....	...	....	.....	476
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
1–2	nn D	72.70	1–2	nn D??	72.77	2	n D	72.15	...	D??	.....	4772.7
...	....	.....	...	nn B?	74.78	...	....	.....	3–4	n B	75.18	4775.0
...	....	.....	...	....	.....	...	....	.....	1–2	n D??	76.82	4776.8
...	B	74.0	...	....	.....	...	B	73.2	...	....	.....	4773.7
...		78.7	...	....	.....	...		78.4	...	....	.....	4778.3
2	n D	84.54	1	n D	84.78	...	nn D?	84.32	1	n D?	84.84	4784.5
1	n D	89.78	1–3	n D	89.67	1	n D	89.35	...	n D?	89.66	4789.5
...	....	.....	...	....	.....	max	B	94.37	...	B?	.....	4794.4
...	....	.....	...	....	.....	...	B	90.4	...	....	.....	4790.3
...	....	.....	...	....	.....	...		96.2	...	....	.....	4796.3
max	B	02.27	...	....	.....	...	....	.....	...	....	.....	4802.4
1–2	n D	06.89	...	wn D??	06.30	...	wn D	05.82	1	n D??	05.74	4806.2
1	n B?	11.34	...	....	.....	2	n B?	10.20	...	....	.....	4810.7
1	nn D	12.28	...	....	.....	1	n D	11.72	...	....	.....	4812.0
...	....	.....	...	B??	.....	2	n B?	13.92	...	....	.....	4814.0
3	wn D	16.06	1–3	n D??	15.93	...	....	.....	1–2	n D??	16.15	4815.9
...	B	(16.9)	...	....	.....	...	B	16.8	...	....	.....	4817.2
...		21.7	...	....	.....	...		22.1	...	....	.....	4822.3
...	nn D	24.02	1	n D?	23.96	1	n D	23.27	1–2	n D??	23.86	4823.8
4	n B	26.29	1–2	B??	26.05	2	n B?	25.69	...	B?	25.85	4826.0
...	....	.....	...	B	24.7	...	....	.....	...	B	24.7	482
...	....	.....	...		27.1	...	....	.....	...		26.9	
3	n D	28.31	2	n D?	28.19	1–2	n D	27.88	1–2	n D	27.90	4827.9
3–4	B	30.66	2–4	B	30.31	2–3	n B?	30.12	4–5	n B	30.56	4830.4
4–5	D	32.61	2–3	D	32.30	1–2	n D	32.48	4–6	D	32.46	4832.5
...	....	.....	...	....	.....	...	....	.....	...	....	.....	4836.3
1	nn D	40.27	0–1	n D??	39.45	...	....	.....	...	n D??	38.93	4839.5
...	....	.....	1	n D	43.50	...	....	.....	1–2	n D	43.48	4843.4
...	....	.....	...	....	.....	...	....	.....	1–2	n B	45.16	4845.2
...	....	.....	...	B	56.1	...	....	.....	...	con.	56.7	4856.4
...	....	.....	...		59.0	...	....	.....	...	spec.	59.1	4859.1
1	nn D	51.97	1	n D?	51.40	...	nn D?	51.87	1	nn D	51.91	4851.8
1–2	n D	55.73	...	nn D??	55.19	...	....	.....	...	....	.....	4855.5
2	n B	57.76	max	B??	57.77	...	....	.....	2–3	B	58.05	4857.7
1	nn D?	59.99	1	nn D??	59.29	...	....	.....	1	n D	59.65	4859.6
2	nn B	61.45	...	....	.....	max	B	61.46	1–2	n B??	60.72	4861.3

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
279	...	B	4860.1 4862.9	...	....	.....	...	....	.....	...	....	.....
280	3	n D	4865.11	...	....	.....	...	....	.....	I	nn D	66.1
281	3	nn D	(4865.11)	...	....	.....	...	....	.....	I	nn D	(66.11)
282	...	....	....	...	....	.....	...	....	.....	...	....	.....
283	...	....	....	...	....	.....	...	nn D?	71.83	I	n D	71.90
284	...	nn D	4875.27	...	....	.....	...	nn D	76.14	...	nn D	75.8
285	...	....	....	...	....	.....	...	....	.....	...	....	.....
286	max	B	(4878.53?)	...	B?	.....	...	....	.....	...	....	.....
287	...	B	4876.6 4880.5	...	....	.....	...	....	.....	...	....	.....
288	...	nn D?	4882.07	2-3	n D	81.69	3	n D	81.55	2-3	n D	81.75
289	...	....	....	...	....	.....	...	....	.....	...	....	.....
290	...	....	....	...	....	.....	...	....	.....	...	....	.....
291	...	....	....	...	....	.....	...	....	.....	...	....	.....
292	...	....	....	...	....	.....	...	....	.....	...	....	.....
293	...	nn D?	4890.03	...	....	.....	...	....	.....	I	w D	90.9
294	max	B	4898.14	...	....	.....	...	....	.....	max	B	98.88
295	...	B	4595.7 4899.8	...	....	.....	...	....	.....	...	....	.....
296	1 2	nn D	4900.70	2	nn D	00.81	2-3	n D	00.95	...	wn D	01.37
297	...	....	....	...	....	.....	...	....	.....	...	....	.....
298	...	....	....	...	....	.....	...	....	.....	...	....	.....
299	...	....	....	...	....	.....	...	....	.....	...	....	.....
300	...	....	....	...	....	.....	...	....	.....	...	....	.....
301	...	....	....	...	....	.....	...	....	.....	...	....	.....
302	...	nn D?	4920.65	I	n D	21.03	...	wn D	20.78	...	wn D	20.97
303	...	....	....	...	....	.....	...	....	.....	...	....	.....
304	...	....	....	1	n D?	24.91	I	nn D	25.24	...	....	.....
305	...	....	....	...	....	.....	1	D	34.47	...	w D?	34.14
306	...	....	....	...	....	.....	...	....	.....	...	....	.....
307	...	....	....	...	....	.....	1-2	n D	58.40	...	....	.....
308	...	....	....	...	....	.....	...	....	.....	...	....	.....
309	...	....	....	...	....	.....	...	....	.....	...	....	.....
310	...	head	5169.7	...	head	68.0	...	head	68.8	...	....	.....
311	...	....	....	...	....	.....	...	....	.....	...	....	.....
312	...	....	....	5	wD	73.57	...	....	.....	3-4	D	73.21
313	...	....	....	...	B??	.....	max	B	76.5	...	....	.....
314	...	....	....	...	....	.....	...	....	.....	...	....	.....
315	...	nn D	5183.83	4-5	D	83.65	...	nn D	83 72	...	....	.....
316	...	....	....	...	....	.....	...	....	.....	...	D	81.7 85.5
317	...	....	....	1-2	B	87.31	...	....	.....	...	....	.....
318	...	....	....	...	....	.....	...	B	85.5 91.7	...	B??	85.5 91.4
319	...	....	....	...	....	.....	...	....	.....	...	....	.....
320	...	....	....	...	....	.....	...	....	.....	...	....	.....
321	2 3	n D	5193.81	3	D	93.06	...	....	.....	4	D	93.03
322	...	....	....	1-2	n B	97.10	...	....	.....	max	B	97.18
323	...	....	....	...	....	.....	...	....	.....	...	....	.....
324	...	....	....	1-2	n B??	04.02	...	....	.....	...	....	.....
325	...	....	....	...	....	.....	...	B	94.8 01.5	...	....	.....
326	...	....	....	...	....	.....	...	....	.....	...	....	.....
327	...	....	....	...	w D	08.35	...	....	.....	...	....	.....
328	...	w D	5209.97	...	....	.....	...	....	.....	...	D	10.19
329	...	D	5204.3 5213.0	...	....	.....	...	D	04.9 11.7	...	D	04.6 11.1
330	...	....	....	3 4	B	14.63	...	....	.....	...	....	.....
331	...	....	....	1	n D	16.75	2	n D	16.53	...	D??	16.58
332	...	....	....	3	n B	18.75	...	....	.....	...	....	.....
333	...	....	....	...	....	.....	...	B	17.5 24.6	...	B	(12.2) 24 2
334	8	wn D	5226.19	6	wn D	26.19	6	wn D	26.33	6-8	wn D	26.17

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			Mean Wave-Length
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	....	.....	...	....	.....	...	B	{55.5	...	....	.....	486
...	....	.....	...	....	.....	...		65.8	...	....	.....	......
...	....	.....	...	....	.....	...	....	.....	1	nn D??	65.09	4865.1
...	....	.....	1	n D??	67.74	1–2	n D	67.43	...	nn D??	67.49	4867.7
1–2	B	69.82	3	n B??	69.26	...	....	.....	3	n B	68.97	4869.4
3	n D	71.57	2	n D??	71.43	...	....	.....	2–4	n D	71.32	4871.6
1–2	n D?	75.56	2–3	n D??	75.52	...	....	.....	2	n D	75.33	4875.6
...	....	.....	...	....	.....	...	....	.....	1	nn D??	78.32	4878.3
1–2	n B	79.81	5	wn B??	79.45	...	....	.....	2–3	n B	79.61	4879.6
...	....	.....	...	....	.....	...	....	.....	...	....	.....	{487
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
3	D	81.71	2–5	D	81.53	1	n D	81.09	4–7	D	81.52	4881.6
...	....	.....	...	....	.....	...	....	.....	4	n B	83.49	4883.5
...	....	.....	...	D??	.....	...	....	.....	3–5	n D	85.90	4886.0
...	....	.....	...	....	.....	...	....	.....	...	D	{84.5	{488
...	....	.....	...	....	.....	...	....	.....	...		87.3	
...	....	.....	...	....	.....	...	....	.....	2–3	n B	88.04	4888.0
...	nn D?	91.1	1–2	n D??	91.11	1–2	n D	89.88	1	n D	90.8	4890.3
3	nn B?	98.80	max	B??	98.90	...	....	.....	3–8	n B?	98.70	4898.7
...	....	.....	...	....	.....	...	B	{93.2	...	B	{92.2	4893
...	....	.....	...	....	.....	...		01.4	...		00.3	4900.5
1	n D	01.34	1–2	n D?	00.67	2	D	01.87	3	n D	01.18	4901.1
...	....	.....	...	....	.....	...	....	.....	5–6	n B?	03.78	4903.8
...	....	.....	...	....	.....	...	....	.....	...	B	{02.3	{490
...	....	.....	...	....	.....	...	....	.....	...		04.9	
...	....	.....	...	....	.....	...	....	.....	3–4	wn D?	06.41	4906.4
...	....	.....	...	B??	.....	...	....	.....	3–4	n B?	08.42	4908.4
...	....	.....	1	nn D?	09.83	...	....	.....	3	n D	10.59	4910.2
2–3	wn D	21.00	4	wn D??	20.52	1	nn D?	21.23	4–5	wn D??	20.54	4920.8
...	....	.....	...	D	{19.1	...	....	.....	...	....	.....	{491
...	....	.....	...		21.5	...	....	.....	...	....	.....	
1	n D?	25.39	1	n D??	25.03	1	n D	24.91	...	....	.....	4925.1
1	n D	33.81	2–3	n D	34.01	...	....	.....	...	....	.....	4934.1
...	....	.....	...	....	.....	...	....	.....	1–2	n D	45.60	4945.6
...	nn D?	57.60	2	n D??	58.05	...	....	.....	2	n D??	57.68	4957.9
...	....	.....	...	wn D	82.02	...	wn D	81.65	...	....	.....	4981.8
...	....	.....	...	....	.....	2	n D	67.24	...	....	.....	5167.2
...	....	.....	...	....	.....	...	head	68.2	...	head	67.6	5167.9
...	....	.....	...	B??	68.04	...	B?	{68.2	...	....	.....	5167.9
...	....	.....	...	....	.....	...		72.8	...	....	.....	5172.8
6	wn D	73.30	3–4	n D	72.85	4	n D	73.79	8	D	73.27	5873.3
...	....	.....	...	....	.....	...	....	.....	2	B??	75.43	5175.4
...	....	.....	...	....	.....	...	B	{75.0	...	....	.....	{517
...	....	.....	...	....	.....	...		83.2	...	....	.....	
1	n D	83.94	...	w D	83.50	2–5	n D	83.61	5–6	n D	84.08	5183.8
...	....	.....	...	D	{81.2	...	....	.....	...	....	.....	5181.5
...	....	.....	...		85.2	...	....	.....	...	....	.....	5185.4
...	....	.....	...	B?	.....	...	B	86.7	7	B	87.36	5187.3
...	....	.....	...	B	{85.2	...	B	{85.3	...	....	.....	5185.4
...	....	.....	...		91.9	...		92.2	...	....	.....	5191.8
1	n D	89.17	1	nn D??	89.23	1	n D?	89.43	2	D??	89.09	5189.2
...	....	.....	...	B?	.....	2	n B	90.80	7	B	90.97	5190.9
3	wn D	93.21	3	n D	93.04	...	n D	93.69	6	D	93.30	5193.3
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5197.1
...	....	.....	...	D??	.....	...	....	.....	1	D	02.43	5202.4
...	....	.....	...	....	.....	...	....	.....	2	B??	03.85	5203.9
...	....	.....	...	B	{94.3	...	B	{95.8	...	....	.....	5194.9
...	....	.....	...		04.1	...		04.9	...	....	.....	5204.5
2	n D	05.84	...	....	.....	...	....	.....	2–3	n D	05.86	5205.8
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5208.4
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5210.1
...	....	.....	...	D	{04.1	...	D	{05.0	...	....	.....	5204.6
...	....	.....	...		11.8	...		13.0	...	....	.....	......
2	nn B?	14.22	...	B?	.....	4	n B	14.35	5	B??	14.41	5214.4
1–2	n D?	16.68	1	nn D??	16.52	...	nn D?	16.67	5	n D	16.84	5216.7
...	....	.....	...	B??	.....	...	....	.....	4	B??	19.12	5218.9
...	....	.....	...	....	.....	...	B	{18.0	...	....	.....	......
...	....	.....	...	....	.....	...		25.0	...	....	.....	5224.6
9	wn D	26.35	5	D	27.28	8	nn D	26.78	5	D	26.98	5226.5

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
335	...	....	....	2	B??	29.70	...	n B?	(29.81)	...	....	.....
336	...	....	....	...	....	.....	...	....	.....	...	B	28.8 33.3
337	...	n D	5234.33	3	D	34.27	2–3	D	34.22	2	n D	33.95
338	...	....	....	...	....	.....	...	....	.....	2	n B?	37.06
339	...	....	....	1	D	39.94	2	n D	39.69	...	nn D?	40.12
340	...	....	....	...	B??	.....	...	....	.....	2–3	nn B??	44.80
341	2	n D	5247.48	5	D	47.56	2	n D	47.34	3	n D	47.32
342	...	....	....	...	....	.....	...	....	.....	...	....	.....
343	1	n D	5251.3	5	D	51.44	2–3	n D	51.28	2	n D	51.66
344	...	....	....	1	n D?	55.96	2	nn D	55.60	...	....	.....
345	...	nn D?	5265.26	...	....	.....	...	....	.....	...	D?	65.75
346	4–5	n D	5270.62	6	D	70.46	5	n D	70.02	3	w D	70.17
347	...	....	....	2	n B??	79.59	2	n B??	79.68	...	....	.....
348	2–3	n D	5283.24	1–2	n D?	83.17	...	....	.....	1	n D	83.91
349	2	n D	5298.16	4–5	n D	98.19	4–5	n D	97.77	3	nn D	97.70
350	1	n D	5302.72	2	n D	02.76	1	nn D	02.24	1–2	n D	02.47
351	...	....	....	2–3	B	05.26	2–3	nn B	04.84	...	....	.....
352	...	nn D	5307.97	...	....	.....	...	....	.....	1	nn D	07.17
353	...	....	....	2	n B	13.22	3	n B	12.98	...	....	.....
354	...	nn D	5315.31	2	n D	15.27	2–3	n D	15.12	1–2	n D	15.30
355	...	....	....	4	n B	17.91	6	wn B	17.57	8	n B	17.50
356	...	nn D?	5320.95	2	n D	20.99	2	n D	(20.61)	...	....	.....
357	...	....	....	1	n D??	25.32	...	....	.....	...	....	.....
358	...	w D	5329.80	5	w D	29.03	4	D	28.70	2–3	n D	29.00
359	...	nn D?	5337.05	1–2	n D	36.94	1	n D	36.83	2	n D	36.65
360	...	....	....	3	n B	39.36	3	B?	39.05	4	n B??	38.70
361	1	n D	5341.84	2	D	41.30	4	D	41.25	2	n D	41.35
362	...	....	....	...	....	.....	...	....	.....	...	....	.....
363	3–4	D	5350.43	3	wn D	50.07	...	....	.....	2	n D	49.83
364	2	B	5353.37	2	n B	52.71	...	....	.....	...	....	.....
365	...	....	....	...	....	.....	...	B	51.1 61.1	...	....	.....
366	...	....	....	1	D	62.99	...	....	.....	...	nn D	61.89
367	...	....	....	2	n D	66.94	2	n D	66.47	1	D	66.35
368	...	....	....	2	B	68.78	3–4	n B	68.68	...	....	.....
369	9	w D	5372.07	8–9	w D	71.70	6	D	71.50	6	w D	71.52
370	...	....	....	...	....	.....	...	....	.....	...	....	.....
371	2–3	B	5375.22	6	B	75.38	7	n B	74.92	8	n B	74.76
372	...	nn D	5377.48	1–2	D	77.58	2	n D	77.36	2	n D	77.38
373	...	....	....	...	....	.....	...	....	.....	...	....	.....
374	max	B	5380.54	2	n B	79.82	6–8	n B	79.72	6	n B	79.91
375	...	....	....	...	....	.....	...	....	.....	...	....	.....
376	...	B?	5378.0 5381.5	...	....	.....	...	....	.....	...	....	.....
377	...	....	....	...	....	.....	...	....	.....	...	nn D?	84.69
378	...	nn D	5391.56	1	n D	91.09	...	....	.....	...	D??	.....
379	...	....	....	...	B?	.....	...	....	.....	3	n B?	93.01
380	...	....	....	...	....	.....	...	....	.....	...	....	.....
381	5	D	5397.47	3	D	97.58	4	wn D	96.81	3	n D	97.28
382	...	....	....	2	B	04.06	max	B	03.72	...	....	.....
383	...	B	5399.9 5405.7	...	....	.....	...	....	.....	...	B	98.8 05.3
384	...	D?	5406.26	1	n D	06.43	...	....	.....	1	n D	06.28
385	...	....	....	...	....	.....	...	....	.....	...	....	.....
386	1	B?	5408.34	...	....	.....	...	....	.....	...	....	.....
387	3	n D	5410.55	3	D	10.28	1	n D	10.37	3–4	n D	10.31
388	...	....	....	1–2	B	12.64	1	B	12.46	1	n B	12.32
389	...	....	....	1	D	14.45	1	n D	13.91	...	....	.....
390	max	B	5418.34	7	B	17.29	...	w B	16.64	6	B	17.01
391	...	B	5413.5 5419.1	...	....	.....	...	....	.....	...	....	.....
392	2–3	n D	5420.44	2–3	n D	20.17	2–3	n D	20.22	3–4	n D	19.66
393	1–2	B??	5423.39	4	B	23.23	6	B	22.78	2–3	B	22.97
394	1	D	5425.90	1	D	25.24	1	nn D	24.82	...	....	.....
395	1–2	B?	5427.39	3–4	B	27.99	5	n B?	(26.67)	2	n B	27.09
396	...	n D	5430.33	3	D	30.39	4	n D	30.13	3–4	n D	29.87

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			Mean Wave-Length
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	....	.....	...	....	.....	...	B	30.73	6	B??	30.23	5229.2
...	....	.....	...	....	.....	...	B	{ 28.6	...	....	.....	5228.7
...	....	.....	...	....	.....	...		} 32.6	...	....	.....	5233.0
3–4	n D	33.97	3	n D	33.91	2–3	n D	33.99	5	D	33.44	5234.0
...	....	.....	max	B	36.52	6	wn B	36.70	10	B	36.22	5236.6
...	....	.....	1	n D??	39.79	...	nn D	39.96	1–2	n D??	38.98	5239.8
...	....	.....	...	B??	.....	3	wn B	44.70	3	B??	44.87	5244.8
5	n D	47.43	3	n D	47.41	3	nn D	47.19	6	D	47.21	5247.4
...	....	.....	...	....	.....	...	....	.....	5	B?	49.22	5249.2
3	n D	51.47	3	D	51.46	...	nn D	51.83	8	D	51.31	5251.5
1	nn D?	55.25	1	n D	55.60	...	....	.....	2	D	55.31	5255.5
...	....	.....	...	....	.....	...	....	.....	1	D	66.22	5265.7
3	n D	70.55	4–5	D	70.41	5	n D	70.75	5	D	70.05	5270.4
2	nn B?	79.75	1–2	B??	79.46	...	nn B?	80.10	2	n B?	79.47	5279.7
1	nn D	83.43	1	nn D??	83.90	...	....	.....	1–2	n D	84.33	5283.7
4	n D	97.63	3	D	98.11	2–3	D	98.37	2	n D	97.40	5298.0
2	n D	02.14	1	n D??	02.35	...	....	.....	...	....	.....	5302.4
2	n B	04.97	...	B?	.....	...	nn B	05.13	...	B?	.....	5305.1
1	nn D	07.44	...	....	.....	...	....	.....	...	....	.....	5307.5
2–3	n B	13.07	1	B?	13.43	4	n B	13.13	4	B	13.20	5313.2
2–3	n D	15.09	1–2	n D	15.28	3	n D	15.30	3	D	15.40	5315.3
4	n B	17.58	2	B?	17.76	9	n B	17.81	1–2	B??	17.36	5317.6
...	nn D?	20.19	3	wn D??	21.13	3	nn D	20.71	...	....	.....	5320.8
...	....	.....	...	....	.....	...	....	.....	1	D	25.21	5325.3
3	n D	29.00	4	n D	29.06	...	....	.....	3	D	28.54	5329.0
1–2	n D	36.86	1	n D	36.82	4	n D	36.97	1–2	n D	37.30	5336.9
4	n B??	39.12	...	B??	.....	6	n B	39.29	7	B	39.37	5339.1
2	D	41.59	2–3	n D	41.63	3	n D	41.78	7	D	41.61	5341.5
1	nn B?	44.64	...	....	.....	...	nn B	44.71	6	B	44.31	5344.6
2–3	wn D	49.57	...	....	.....	...	....	.....	...	....	.....	5350.0
1	n B	52.23	1	B??	52.52	4	n B	52.39	3–4	B??	52.25	5352.6
...	....	.....	...	....	.....	...	B	{ 55.4	...	....	.....	{ 535
...	....	.....	...	....	.....	...		} 64.8	...	....	.....	}
...	....	.....	1	n D	62.99	...	....	.....	1	n D	62.50	5362.6
...	nn D	66.51	1–2	n D	66.72	1–2	n D	65.99	3–4	D	66.70	5366.5
3	n B	68.93	2	B	69.05	3	n B	68.71	10	B	69.11	5368.9
6	D	71.68	10	w D	71.89	7	wn D	71.64	9	D	72.10	5371.8
...	....	.....	...	....	.....	...	D	{ 70.1	...	....	.....	{ 537
...	....	.....	...	....	.....	...		} 73.7	...	....	.....	}
4–5	B	75.05	4–5	B	75.15	8	B	75.01	8	B	74.98	5375.1
2	n D	77.38	1	n D	77.44	3	n D	77.29	4	D	77.07	5377.4
...	....	.....	...	....	.....	...	....	.....	3	B	78.92	5378.9
5–6	wn B	80.47	3	n B??	80.46	9	wn B	80.68	...	B	79.91	5380.2
...	....	.....	...	....	.....	...	....	.....	3	n B	81.44	5381.4
...	....	.....	...	....	.....	...	B	{ 78.5	...	....	.....	5378.3
...	....	.....	...	....	.....	...		} 82.1	...	....	82.9	5382.2
...	wn D	84.87	1	n D	84.55	...	....	.....	...	....	.....	5384.7
1	nn D	90.40	...	D?	.....	...	....	.....	...	....	.....	5391.0
...	....	.....	...	....	.....	4–5	wn B??	93.21	...	....	.....	5393.1
...	....	.....	...	....	.....	...	B	{ 87.5	...	....	.....	{ 538
...	....	.....	...	....	.....	...		} 94.1	...	....	.....	}
9	wn D	96.91	1	nn D	97.97	3	wn D	96.75	3	D	97.88	5397.3
...	....	.....	...	....	.....	...	....	.....	1–2	n D??	03.50	5403.8
...	....	.....	...	....	.....	...	B	{ 99.0	...	....	.....	5399.4
...	....	.....	...	....	.....	...		} 08.0	...	....	.....	5405.5
...	....	.....	1	nn D	06.90	...	....	.....	...	....	.....	5406.5
...	....	.....	...	....	.....	...	....	.....	2–3	wn D	08.30	5408.3
...	....	.....	...	....	.....	...	....	.....	...	B?	.....	5408.3
2	nn D	10.01	2	n D	10.59	3	n D	09.80	...	....	.....	5410.3
...	....	.....	1–2	B	12.39	3	n B	12.30	...	....	.....	5412.4
1	n D	14.40	1–2	n D??	14.09	1–2	n D	13.80	1–2	n D??	14.06	5414.1
7–8	n B	17.28	4–5	B	17.06	7–8	wn B	17.00	...	....	.....	5417.2
...	....	.....	...	....	.....	...	....	.....	...	....	.....	{ 541
3	n D	20.53	4	D	20.43	3	nn D?	20.49	2	n D	20.13	5420.3
2	n B	23.13	3	n B	23.05	3	n B	23.45	3	n B	22.50	5423.1
...	....	.....	1–2	n D	25.03	...	nn D?	25.36	1	n D	24.41	5425.1
...	....	.....	...	....	.....	3	n B	27.18	...	....	.....	5427.4
3	n D	30.27	3–4	D	30.33	3	D	30.17	2	D	30.24	5430.2

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
397	1	n B	5432.68	2	B	32.38	2	B	32.13	1	n B	32.14
398	2	n D	5434.66	1–2	D	34.20	1–2	D	33.99	2	n D	34.25
399	2	D??	5439.06	1	D	38.86	1	nn D?	38.06	...	...	...
400	...	...	...	...	...	...	...	...	...	...	...	...
401	...	...	...	4	B	45.19	...	...	...	...	...	...
402	...	B	5440.7 5446.5	...	...	...	...	B	39.2 45.7	...	B	38.6 46.1
403	4	n D	5448.31	6	D	48.09	7–8	n D	47.72	5	n D	47.94
404	6	w B	5452.64	3	B	51.05	5	B	50.60	...	...	...
405	...	...	...	3	B	53.85	3	n B??	(53.02)	...	...	...
406	...	B	5450.3 5455.0	...	...	...	...	...	...	...	...	...
407	4	n D	5456.54	3	D	56.96	2	n D	56.43	2–3	n D	56.54
408	1–2	B	5459.07	2	B	59.14	1	B	58.92	1–2	B	58.63
409	2	D	5461.13	2	D	60.99	2	n D	60.84	2	D	60.49
410	...	...	...	...	B	62.96	2	B	62.60	...	...	...
411	2–3	B??	5464.01	3–4	B	63.76	2	B	...	...	...	...
412	...	...	...	...	B	65.15	...	...	...	...	...	...
413	...	...	...	...	...	...	...	B	61.3 65.7	...	B	61.4 66.2
414	1	n D	5466.93	2	n D	67.83	2	n D	67.06	...	w D	67.60
415	...	...	...	...	D??	... ...	...	D?	65.7 70.3	...	...	...
416	...	...	...	2–3	B	72.43	6	B	72.10	3	n B	71.77
417	1	n D	5475.08	1–2	n D	74.56	2	n D	74.38	2	nn D	74.33
418	...	...	...	1–2	n D??	78.09	2	n D??	77.56	1	n D	77.89
419	...	...	...	4	B	80.89	2–3	n B	(80.03)	4	n B?	80.25
420	1	nn D??	5483.08	2	D	82.73	1	n D	83.05	1–2	nn D	82.64
421	...	...	...	...	...	...	...	...	...	...	...	...
422	...	...	...	...	B??	...	...	...	...	...	...	...
423	...	...	...	3–4	D	98.13	...	...	...	3	n D	97.75
424	...	...	...	...	...	...	...	...	...	2	n D	01.81
425	...	...	...	...	...	...	...	...	...	...	...	...
426	...	...	...	...	head	03.1	...	...	...	...	...	...
427	1	n D	5507.19	1	D??	07.18	0–1	nn D	07.06	1	n D	06.66
428	...	...	...	2–3	n B	09.51	...	...	...	2	n B?	08.64
429	4	n B??	5510.00	2	B	10.72	...	...	...	...	...	...
430	...	con. spec.	5508.6 5512.9	...	...	...	...	...	...	...	...	...
431	...	...	...	1–2	n D??	12.70	...	...	...	2	nn D	12.28
432	...	D	5512.4 5517.9	...	...	...	...	...	...	...	...	...
433	...	con. spec.	5518.2 5527.8	...	...	...	...	B	13.8 23.0	...	...	...
434	...	...	...	1	n D	24.44	2	n D	24.35	1	wn D	24.19
435	...	...	...	...	...	...	...	...	...	...	...	...
436	2	n D	5528.85	1	D??	28.28	1	nn D??	29.09	...	...	...
437	2	n B?	5531.66	2	B	31.96	...	...	...	...	...	...
438	1	n D?	5533.79	1	D	33.87	1	n D	33.89	1	n D	33.66
439	...	...	...	7	wn D	39.73	8–9	n D	39.22	8	wn D	39.25
440	...	D	5537.4 5542.4	...	...	...	...	...	...	...	...	...
441	...	...	...	...	head	41.8	...	head	41.4	...	...	...
442	...	...	...	4	B?	43.44	...	...	...	1–2	B	43.57
443	...	...	...	...	B	41.8 ...	...	B	41.4 47.0	...	...	...
444	...	...	...	...	...	...	...	...	...	...	...	...
445	...	...	...	1	D	48.34	1–2	n D	48.31	...	...	...
446	...	...	...	1	D??	52.42	1	n D	52.53	1	nn D	52.20
447	max	n B	5554.54	3	B	54.29	2	n B	54.35	1	n B?	53.91
448	...	nn D?	5557.27	1	D	56.32	1–2	n D	56.28	1	n D	55.80
449	...	...	...	1–2	D	62.55	1–2	n D	62.68	...	...	...
450	...	...	...	2–3	B	64.49	2	n B	64.70	1–2	B	64.73
451	...	nn D	5567.60	2	D	66.60	1–2	n D	66.86	2	n D	66.57
452	...	...	...	1	D	70.29	1	n D	70.16	0–1	nn D	69.96
453	...	n B?	5572.04	1	B	71.85	...	...	...	...	...	...
454	...	...	...	...	...	...	...	...	...	...	...	...

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			MEAN WAVE-LENGTH
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	....	.....	3	B	32.25	1	n B?	32.15	2	B??	32.23	5432.3
2	n D	34.57	1–2	D??	34.35	...	....	.....	1–2	n D	31.35	5434.3
...	....	.....	...	D??	.....	...	....	.....	2	D	38.93	5438.6
max	B	42.54	...	B??	.....	...	....	.....	3	n B	42.70	5442.6
...	....	.....	...	B??	.....	...	....	.....	...	....	.....	5445.2
...	B	39.7	...	....	.....	...	B	40.3	...	....	.....	5439.8
...		46.0	...	....	.....	...		44.9	...	....	.....	5446.0
9	n D	47.62	8	D	47.73	7	n D	47.54	...	w D	47.06	5447.8
max	B	51.08	max	B	50.91	4–5	B	50.89	4	B	50.90	5450.9
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5453.9
...	B	49.0	...	....	.....	...	....	.....	...	....	....	5449.7
...		55.1	...	....	.....	...	....	.....	...	....	.....	5455.0
1–2	n D	56.81	3	n D	56.92	2	nn D	56.46	1	nn D	57.13	5456.7
...	....	.....	...	....	.....	1	n B?	58.88	...	....	.....	5458.9
1–2	n D	60.96	1–2	n D	60.99	1	n D	60.80	1	nn D	61.18	5460.9
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5462.8
...	....	.....	..	B?	.....	...	....	.....	...	....	.....	5463.9
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5465.2
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5461.4
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5466.0
2	wn D	68.30	1	n D	66.75	...	....	.....	...	....	.....	5467.4
...	....	.....	...	....	.....	...	....	.....	...	....	.....	546
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
2	n B	72.63	3	B?	72.40	5	B	72.31	...	....	.....	5472.3
1	nn D?	74.46	1	n D?	74.20	1–2	n D	74.34	1	D	74.35	5474.5
1	nn D?	78.25	1–2	n D??	78.04	...	....	.....	...	....	.....	5478.0
...	....	.....	...	B??	.....	...	nn B?	80.91	1	B?	81.58	5480.9
1	n D	83.19	1	n D	82.99	...	nn D	83.60	...	....	.....	5483.0
...	....	.....	...	....	.....	...	nn B	86.18	1	B?	87.03	5486.6
...	....	.....	1–2	n B?	95.65	...	....	.....	...	....	.....	5495.7
3–4	D	98.22	5	D	97.92	...	....	.....	...	....	.....	5498.0
...	....	.....	4	n D	02.31	...	....	.....	...	....	.....	5502.1
...	D	96.8	...	....	.....	...	....	.....	...	....	.....	550
...		03.9	...	....	.....	...	....	.....	...	....	.....	
...	head	03.8	...	....	.....	...	head	05.0	...	....	.....	5504.
...	....	.....	1	n D??	06.89	...	....	.....	...	....	.....	5507.0
3	n B	09.59	2	wn B?	08.88	...	....	.....	5–6	B	08.30	5509.0
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5510.4
...	....	.....	...	....	.....	...	B?	05.0	...	....	.....	550
...	....	.....	...	....	.....	...		10.4	...	....	.....	551
3	n D	12.44	2	nn D	12.46	2	nn D	12.20	...	....	.....	5512.4
...	....	.....	...	....	.....	...	....	.....	...	....	.....	551
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
...	....	.....	...	con.	13.9	...	B?	14.5	...	....	.....	5514.
...	....	.....	...	spec.	23.2	...		23.4	...	....	.....	552
...	....	.....	1	n D	24.36	...	nn D	23.95	...	....	.....	5524.3
1–2	wn D	25.45	...	....	.....	2	n D	25.25	...	....	.....	5525.4
...	....	.....	1	nn D??	28.09	...	....	.....	...	....	.....	5528.6
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5531.7
1	nn D?	(34.62)	1	n D	33.86	1	n D	33.96	1–2	wn D	32.6	5533.9
7	D	39.55	8	D	39.81	8	D	39.54	2–3	wn D	39.31	5539.5
...	....	.....	...	....	.....	...	....	.....	...	....	.....	553
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
...	head	42.1	...	....	.....	...	head	41.8	...	....	.....	5541.8
...	....	.....	2–3	n B?	43.61	...	....	.....	...	....	.....	5543.5
...	B	42.1	...	B	44.6	...	B	41.8	...	...	.....	5541.8
...		47.3	...		46.7	...		46.7	...	....	.....	5546.9
...	....	.....	...	....	.....	...	....	.....	1–2	w D	46.56	5546.6
2	n D	48.60	1–2	D	48.03	2–3	n D	48.45	...	....	.....	5548.3
1	n D	52.45	...	....	.....	1–2	D	52.80	1	D	52.64	5552.5
...	....	.....	...	....	.....	2	n B	54.48	...	....	.....	5554.3
1	n D	56.38	1	n D	56.30	2	n D	56.36	1	n D	56.24	5556.4
1	n D	62.76	1	nn D	62.20	1	n D?	62.40	1	n D	62.50	5562.5
...	....	.....	1–2	n B?	64.54	1–2	n B	64.87	...	....	.....	5564.7
1–2	n D	67.23	1	n D	66.84	...	n D?	67.42	4	n D	68.08	5567.2
1	n D	70.36	...	....	.....	...	....	.....	...	....	.....	5570.2
...	....	.....	2	B	71.66	max	B	71.24	...	....	.....	5571.7
...	B	55.	...	....	.....	...	....	67.7	...	....	.....	556.00
...		73.6	...	....	.....	...	B	73.1	...	....	.....	

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
455	...	....	....	1	D	73.57	1	D?	73.9	1	D	73.41
456	...	....	....	...	....	.....	...	....	.....	...	D??	.....
457	1-2	n D	5584.65	8-9	D	83.98	9-10	w D	83.70	9	....	83.98
458	...	....	....	...	D	{ 85.8	...	....	.....	...	....	.....
459	...	....	....	...	head	85.8	...	head	85.6	...	....	.....
460	2	n B	5587.54	4	B	86.95	5	B	86.96	4	B	86.89
461	1-2	n D	5589.99	1-2	n D	89.32	1	D	89.14	1	n D	88.97
462	...	....	....	...	....	.....	...	....	.....	...	....	.....
463	1	n B	5593.21	1-2	n B	92.27	1	n B	92.53	...	....	.....
464	...	....	....	...	....	.....	...	....	.....	...	....	.....
465	...	....	....	1	n D	94.51	1	n D	94.40	1	n D	94.62
466	2	n B?	5597.94	4	B	97.51	6-7	B	97.55	4	wn B	97.37
467	...	....	....	1	n D?	99.60	1	n D	99.81	1	nn D	99.58
468	...	....	....	2	n D??	09.33	...	wn D	09.74	2	n D	09.49
469	...	....	....	...	....	.....	...	....	.....	...	....	.....
470	...	....	....	1	n D	15.56	...	....	.....	...	....	.....
471	...	....	....	2	B??	17.38	2	B	17.42	...	....	.....
472	3	D	5620.92	2	D	20.07	...	nn D	20.31	3-4	D	20.20
473	4	D	5625.96	3	n D	24.71	5	n D	21.68	5	wn D	24.78
474	...	....	....	...	....	.....	...	....	.....	..	D	{ 18.5 26.1
475	...	....	....	1-2	B?	27.70	1	n B	27.76	...	....	.....
476	...	....	....	...	....	.....	...	....	.....	...	....	.....
477	6	B??	5630.26	2	B?	30.69	1	n B?	30.54	...	....	.....
478	...	B	{ 5627.9 5632.0	...	....	.....	...	B	{ 26.1 31.2	...	B?	{ 26.6 32.2
479	7	D	5634.05	10	D	34.21	10	w D	34.11	10	w D	34.20
480	...	....	....	...	....	.....	...	....	.....	...	....	.....
481	...	head	5636.78	...	head	36.23	...	head	37.13	...	head	36.68
482	...	....	....	3	B	37.59	2	n B	37.99	...	....	.....
483	...	....	....	3	B	41.12	...	....	.....	2	n B	41.33
484	...	....	....	...	....	.....	...	B	{ 37.1 42.3	...	....	.....
485	...	nn D	5645.22	1	n D	44.07	1	n D	43.74	2	n D	43.71
486	...	....	....	2	n B??	46.75	...	....	.....	...	....	.....
487	1	n D?	5650.18	1	D??	49.88	...	....	.....	1	nn D	49.85
488	...	....	....	2-3	B	53.00	...	....	.....	...	....	.....
489	...	....	....	3	B??	55.10	max	B	55.42	...	....	.....
490	...	B	{ 5651.3 5657.2	...	....	.....	...	B	{ 45.1 56.4	...	B	{ 44.8 57.2
491	1-2	n D	5658.23	2	D	58.60	...	....	.....	3	n D	58.25
492	...	....	....	...	....	.....	...	....	.....	...	....	.....
493	1	n D	5671.71	1	D	70.83	1	n D	71.44	4	wn D	71.26
494	1	B?	5674.74	3	B??	73.75	4	n B	73.59	2	B?	74.35
495	...	....	....	...	....	.....	...	....	.....	...	....	.....
496	1-2	D	5677.33	1-2	D	76.41	1	n D	76.76	2	wn D	76.74
497	...	....	....	1	n B	79.21	...	....	.....	1	B	79.24
498	...	....	....	1	n B	84.29	...	....	.....	...	....	.....
499	1-2	nn D	(5687.93)	1	n D	87.11	1	D?	(88.0)	1	nn D	86.89
500	...	wn B	5694.41	3	B	93.78	...	wn B	93.89	6	n B	93.62
501	...	....	....	1	D	96.82	1	n D	97.24	...	....	.....
502	...	....	....	...	....	.....	...	....	.....	0-1	B?	00.26
503	2	nn B	5706.71	3-4	B	05.41	5	n B	05.42	3	B	05.25
504	1-2	n D	5708.92	2	D	08.26	4	n D	08.49	2	n D	08.44
505	...	....	....	2	B	10.45	2	n B??	10.81	1	B	11.05
506	...	....	....	1	D	12.94	2	n D	12.91	2	n D	12.88
507	...	....	....	1	B	15.00	...	....	.....	...	....	.....
508	...	nn B	5717.37	4	B	17.05	...	....	.....	4	wn B	17.19
509	...	....	....	4	B	17.87	...	....	.....	...	....	.....
510	...	....	....	...	....	.....	...	B	{ 14.5 20.2	...	....	.....
511	...	....	....	1	n D	21.40	1	n D	21.95	2	n D	21.23
512	2	n B	5724.44	1	B	24.12	4	n B	24.27	3	n B	24.07
513	...	nn D	5731.70	2	n D	31.20	3	n D	31.56	2	n D	31.76

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			MEAN WAVE-LENGTH
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
1	n D	74.45	1	nn D?	73.4	...	....	.....	...	....	.....	5573.7
...	....	.....	1	n D??	76.50	...	....	.....	8	w D	76.16	5576.3
max	D	84.02	9	D	83.86	9	D	83.83	10	w D	83.69	5584.0
...	D	{ 73.6	...	....	.....	...	D	{ 81.9	...	....	.....	5581.9
...		{ 85.9	...	....	.....	...		{ 85.9	...	....	.....	5585.9
...	head	86.03	...	....	.....	...	head	86.21	...	....	.....	5586.0
3	B	87.23	3	B	86.97	6	B	87.66	1	B?	87.57	5587.2
1	n D	89.27	1	n D	88.90	...	....	.....	1	D	88.95	5589.2
...	....	.....	...	....	.....	...	....	.....	10	B?	91.44	5591.4
2–3	n B	92.10	1	n B	91.82	8	B	92.35	2	B	92.58	5592.4
...	....	.....	...	B?	.....	...	B	{ 86.2	...	....	.....	{ 558
...	....	.....	...	....	.....	...		{ 93.5	...	....	.....	
2	n D	94.98	1	n D	94.41	...	n D	95.10	...	....	.....	5594.7
4	B	97.61	2	n B	96.89	4	n B	97.67	...	....	.....	5597.5
1–2	nn D	00.38	1–2	nn D	00.17	1	n D	00.03	...	....	.....	5599.9
...	nn D	09.52	1–2	nn D	09.05	...	wn D	09.83	...	....	.....	5609.5
...	D	{ 07.6	...	....	.....	...	D	{ 08.1	...	D	{ 06.9	5607.5
...		{ 12.1	...	....	.....	...		{ 12.2	...		{ 16.0	5612.2
...	....	.....	1	n D	15.42	...	....	.....	1	D	16.09	5615.7
...	....	.....	1–2	n B?	17.11	...	....	.....	...	....	.....	5617.3
2	n D	20.18	3	n D	20.00	...	nn D?	20.17	...	....	.....	5620.3
...	nn D	25.38	4	n D	24.61	...	nn D	25.64	...	....	.....	5625.1
...	D	{ 18.6	...	D	{	...	....	.....	...	D	{ 18.8	5618.6
...		{ 27.1	...		{ 26.6	...	....	.....	...		{ 25.4	5626.2
...	....	.....	...	B??	26.5	...	....	.....	...	....	.....	5627.7
...	....	.....	..	....	.....	...	....	.....	...	w B??	29.00	5629.0
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5630.5
...	....	.....	...	con.	{ 26.50	...	B	{ 27.4	...	....	.....	5626.9
...	....	.....	...	spec.	{ 31.40	...		{ 32.3	...	....	.....	5631.8
10	D	34.23	10	D	33.79	10	D	34.58	10	w D	33.76	5634.1
...	....	.....	...	....	.....	...	D	{ 32.3	...	....	.....	{ 5630
...	....	.....	...	....	.....	...		{ 37.6	...	....	.....	
...	head	36.79	...	head	36.60	...	head	37.49	...	head	36.11	5636.9
8	n B	38.64	2–3	n B	37.87	...	....	.....	6	B	38.06	5638.0
6	B	41.65	2–3	n B	40.74	...	....	.....	4	B	41.46	5641.3
...	B	{ 36.8	...	....	.....	...	B	{ 37.6	...	....	.....	5637.2
...		{ 42.5	...	....	.....	...		{ 43.6	...	....	.....	5642.8
2	n D	44.29	...	wn D	43.89	...	nn D	45.20	1	n D	44.57	5644.3
...	....	.....	1–2	n B?	46.15	...	n B	46.21	...	....	.....	5646.4
1	nn D	50.24	...	....	.....	...	....	.....	...	....	.....	5650.2
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5653.0
2	n B?	55.24	1	n B?	55.42	max	B	55.30	...	....	.....	5655.2
...	....	.....	...	....	.....	...	B	{ 46.3	...	....	.....	5645.4
...	....	.....	...	....	.....	...		{ 56.7	...	....	.....	5656.9
1	nn D	57.63	1	n D	57.93	...	nn D	58.05	0 1	D	57.32	5658.0
...	....	.....	...	....	.....	...	B	{ 59.2	...	....	.....	{ 565
...	....	.....	...	....	.....	...		{ 70.4	...	....	.....	
3	n D	71.34	1	nn D	70.99	1–2	n D	71.68	1	nn D	71.22	5671.3
2	n B?	73.93	...	B??	.....	2	n B	74.3	...	....	.....	5674.1
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5675.5
2	n D	76.47	1	n D	76.48	1	n D	76.67	...	....	.....	5676.7
2	n B?	79.45	...	B??	.....	2	n B	79.96	2	B	79.49	5679.5
1–2	n B?	83.81	...	....	.....	2	n B	84.21	...	....	.....	5684.1
2	n D	86.53	1	n D	86.29	...	....	.....	4	D	86.59	5686.6
8	wn B	93.79	4	B	93.21	8	n B	94.16	5	B	93.17	5693.8
1	nn D	96.33	1	nn D	96.72	1	n D?	97.18	1	D	95.80	5696.7
...	....	.....	...	....	.....	2	n B	99	...	B??	.....	5699.8
5	n B	05.05	3	B	04.53	6	n B	05.14	1–2	B	04.97	5705.3
3–4	n D	08.03	2	n D	08.23	1	n D?	08.09	2	D	07.89	5708.3
...	....	.....	1	B??	10.71	...	....	.....	...	B??	.....	5710.8
1	n D	13.19	1–2	n D	12.33	1	n D?	13.12	1	n D	12.49	5712.8
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5715.0
8	wn B	17.23	5	nn B?	16.31	8	n B	17.17	8	B	16 49	5717.0
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5717.9
...	....	.....	...	B	{ 14.1	...	....	.....	...	....	.....	5714.3
...	....	.....	...		{ 19.6	...	....	.....	...	....	.....	5719.9
2	n D	21.46	1	n D	21.5	...	....	.....	4	n D	20.68	5721.4
6	wn B	24.28	3	n B?	24.00	8	n B	24.86	6	B	23.80	5724.2
8	n D	31.48	3	D	30.72	2	n D	31.97	6	w D	31.60	5731.6

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

No.	280 *Schjellerup*			19 *Piscium*			318 *Birmingham*			74 *Schjellerup*		
	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length
			t.m.			t.m.			t.m.			t.m.
511	...	...	...	...	...	...	...	...	...	...	D	26.6
	...	...	...	...	...	...	...	...	...	...		33.4
515	...	B	5734.2	...	...	...	...	B	33.8	...	...	...
	...		5743.1	...	...	...	...		41.7	...	...	...
516	...	nn D	5741.32	2	n D	41.35	...	nn D	43.89	1	nn D?	43.96
517	...	...	...	4	n B??	47.09	...	...	...	...	...	...
518	...	...	...	1	n D	49.59	...	nn D	49.73	...	...	...
519	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
520	1	n D	5751.70	...	...	...	...	...	...	...	...	...
521	2-3	wn B	5758.05	3	n B	57.02	max	B	57.08	...	...	...
522	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
523	...	wn D	5763.7	2	n D	62.53	...	nn D	62.53	1	n D	63.66
524	2	n B	5768.79	2	n B?	67.29	...	...	...	...	...	...
525	1	n D	5772.1	2	n D	71.19	...	nn D	71.35	...	wn D	71.59
526	...	...	...	...	...	...	...	...	...	...	...	...
527	1	n B?	5775.81	...	...	...	...	...	...	...	...	...
528	...	...	...	1	n D??	77.82	1	n D	78.48	1	nn D?	77.86
529	2	n B	5780.77	1-2	B	79.86	...	...	...	...	...	...
530	...	...	...	...	...	...	...	...	...	...	B	73.5
	...	...	...	...	...	...	...	...	...	...		82.0
531	2	n D	5785.57	...	...	...	2	wn D	84.41	...	...	...
532	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
533	...	...	...	...	...	...	...	...	...	...	...	...
534	...	...	...	...	...	...	...	...	...	...	D	82.0
	...	...	...	...	...	...	...	...	...	...		91.3
535	...	...	...	1	D	98.68	1	nn D?	99.1	1	nn D	98.50
536	...	...	...	1	n D	22.69	...	...	...	2	n D	22.92
537	...	...	...	...	...	...	1	n D	48.46	...	...	...

WAVE-LENGTHS OF LINES IN THE VIOLET REGION OF 19 *PISCIUM*

As already stated, the violet region of 19 *Piscium* was photographed with a one-prism spectrograph attached to the two-foot reflector (Figs. 1 and 2, Plate XI). With the light flint prism and the very short camera of this spectrograph, the scale of the resulting spectrum was too small to permit of precise determinations of wave-length. The results of the measures of plates R 34, 37, and 38 by Mr. Parkhurst are nevertheless valuable, as they permit some of the important lines to be identified, and in fact furnish the only knowledge we have of the positions of lines in this part of the spectrum of fourth-type stars.

Three plates were measured, the numbers, exposure times, and range of spectrum in which the lines were good enough to measure being:

Plate	Exposure	Lines Measured
R 34	5^h 30^m	4255 to 4327
37	7 45	4079 to 4380
38	24 40	3969 to 4373

The wave-lengths of the star lines on the long-exposure plate R 38 could not be deduced directly from the plate, since there was a shift of the comparison lines due to the exposure being extended over four nights. Therefore a correction was made to the wave-lengths of R 38, deduced by comparison with seven of the best star lines common to R 37 and R 38. This correction, for the seven lines, varied from 2.8 to 6.4 t.m., so that the mean is uncertain by as much as 2 t.m. The uncertainty

TABLE OF MEAN WAVE-LENGTHS CORRECTED FOR RADIAL VELOCITY—*Continued*

78 *Schjellerup*			132 *Schjellerup*			115 *Schjellerup*			152 *Schjellerup*			MEAN WAVE-LENGTH
Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	Intensity	Character	Wave-Length	
		t.m.			t.m.			t.m.			t.m.	t.m.
...	....	.....	...	....	.....	...	....	.....	...	D	{	{ 572
...	....	.....	...	....	.....	...	....	.....	...		33.9	
...	....	.....	...	B	{ 33.0	...	B	{ 33.5	...	B	{ 33.9	5733.8
...	....	.....	...		41.4	...		42.6	...		41.3	5742.0
3	n D	43.02	1	nn D	43.60	1	n D?	43.73	2	D	43.26	5743.8
...	....	.....	...	....	.....	...	....	.....	2	B?	46.06	5746.6
2	nn D	49.85	1–2	nn D	49.43	1	n D	48.83	3	D	48.98	5749.4
...	D	{ 42.2	...	....	.....	...	....	.....	...	....	.....	{ 574
...		50.8	...	....	.....	...	....	.....	...	....	.....	
...	....	.....	...	....	.....	...	....	.....	...	....	.....	5751.7
...	....	.....	2	n B?	56.23	max	B	57.55	2	n B	56.41	5757.1
...	....	.....	...	....	.....	...	B	{ 53.0	...	....	.....	{ 575
...	....	.....	...	....	.....	...		61.4	...	....	.....	
3	n D	62.23	2	n D?	61.72	1	n D	62.95	...	....	.....	5762.6
...	....	.....	1–2	B?	66.82	3	n B	67.63	1–2	B	67.09	5767.5
3	n D	70.71	...	....	.....	...	nn D	71.39	2	D	70.10	5771.1
...	....	.....	...	B?	.....	...	....	.....	3	B	73.33	5773.3
...	....	.....	...	....	.....	1–2	n B?	76.41	...	....	.....	5776.1
...	....	.....	...	D??	.....	...	....	.....	...	....	.....	5778.1
...	....	.....	1–2	B?	79.65	2	n B	80.87	4	B	80.11	5780.3
...	B	{ 71.9	...	B	{ 71.5	...	....	.....	...	....	.....	5772.3
...		80.5	...		80.9	...	....	.....	...	....	.....	5781.1
3	wn D	85.23	...	....	.....	...	wn D	84.81	5	w D	84.11	5784.8
...	....	.....	...	D	{ 80.9	...	....	.....	...	....	.....	{ 578
...	....	.....	...		86.7	...	....	.....	...	....	.....	
1	nn D?	89.93	...	D??	.....	...	....	.....	1	D	89.40	5789.7
...	....	.....	...	....	.....	...	....	.....	...	....	.....	{ 578
...	....	.....	...	....	.....	...	....	.....	...	....	.....	
2	n D	97.61	1	n D	97.60	...	....	.....	1	n D	97.32	5798.1
1	nn D	23.44	2	n D	22.11	...	....	.....	1	D	22.09	5822.7
1	n D	49.82	...	....	.....	...	....	.....	...	....	.....	5848.6

of the adopted wave-lengths is increased by the poor quality of the comparison lines on R 37, which has the best star lines.

The star line $H\delta$ is nebulous on plate R 38, and apparently 5 t.m. wide; the uncorrected wave-length is 4103.5; corrected wave-length, 4100.4. On plate R 37 the line seems quite narrow and sharp, the wave-length being 4100.5. The correction to reduce to the wave-length in the Sun, +1.5 t.m., is within the errors of measurement.

The mean wave-lengths from the three plates are given in the following table:

LINES IN THE VIOLET REGION OF 19 *PISCIUM*

Plates R 34, 37, and 38

Intensity	Character	No. Plates	Wave-Length	Solar Lines	Intensity	Character	No. Plates	Wave-Length	Solar Lines
Spec.	begins	..	393	K	..	Limits	..	{ 4224.4 4233.3	
..	wn D	1	3967.0	H 3968.6 *Ca*	..	n D	1	4254.4	
..	nn D?	1	4004.4		..	nn D	2	4274.0	
..	nn D	1	4018.3		1	n D	1	4282.8	
1	n D	1	4034.8		..	n D	3	4289.0	
3	n D	1	4058.2		..	w D	2	{ 4303.5 4312.6	G group
..	nn D	2	4078.7						
4	n D	2	4100.5	$H\delta$ 4102.0	..	nn D	2	4325.9	
..	nn D?	2	4132.3		3	D	1	4340.4	$H\gamma$ 4340.6
..	wn D	1	4145.4		2	D	1	4354.2	
..	nn D?	1	4197.5		2	D	1	4363.4	
10	D	2	4227.6	*Ca* 4226.9	6	D	1	4383.7	

WAVE-LENGTHS OF LINES IN THE RED REGION OF 152 *SCHJELLERUP*

Plate G 211, taken on an Erythro plate with camera No. 2 and a single dense flint prism, gives the approximate positions of the lines in the red and orange region of the spectrum of 152 *Schjellerup*. The following measures were made by Mr. Ellerman. On account of the small scale of the spectrum in this region, they may be considerably in error, but they suffice for the identification of some of the strongest lines. This photograph is reproduced in Plate VI.

LINES IN THE RED REGION OF 152 *SCHJELLERUP*

Plate G 211

Intensity	Character	Wave-Length	Remarks
		t.m.	
2	B	5592.4	
..	D	5731.1	End of zone
2	D	5748.9	
1	B?	5757.4	
1	B?	5778.2	
1	n D	5808.4	
..	B?	5845.3	Very n
10	D	5894.3	Sodium, D_1 and D_2
1	n D	5921.9	
1	D	5945.9	
1	B	6020 8	
1	B	6050.0	
1	n D	6059.1	
..	B	6086.1	Brightest part of bright band
3	D	6098.5	
7	B	6108.4	
2	D	6119.0	
8	B	6130.5	Double?
2	B	6154.9	
10	B	6176.0	
2	D	6190.3	
10	B	6200.9	
..	B	6222.1 6253.4	Band increasing from to
10	D	6269.6	Very broad
1	B	6310.8	
1	B	6330.2	
3	D	6357.6	
..	D	6425.3	Center of broad, hazy band
3	B	6444.8	
..	....	6488.2	Spectrum drops off here, dark space
..	....	6587.5	to
..	....	6631.	end of faint continuous spectrum

PRECISION OF THE MEAN WAVE-LENGTHS

The sources of error in this investigation are numerous, and render it impossible to secure a high degree of precision in the results. In the spectrograph the wide slit necessarily employed, the instability of the prism supports, and the variations in temperature of the prisms during the long exposures, tended to produce wide and diffuse lines on the photographs, and to introduce irregular displacements of unknown magnitude. In comparison with these sources of error, which affect both stellar and comparison spectra, all errors due to the measuring machines or to the method of reduction are comparatively unimportant and may be neglected. During the progress of this research the old spectrograph was used by Messrs. Frost and Adams for the measurement of stellar motions in the line of sight. Most of this work was confined to bright stars having well-defined lines in their spectra. But, in spite of the short exposures required for such objects, errors arising from unknown causes were frequently apparent in the results. For example, the star ϵ *Leonis*, as photographed on seventeen occasions between February 11 and April 25, 1900, gave velocities ranging from -10 to $+13$ km. This led to the belief that ϵ *Leonis* varied in its radial velocity, but it was afterward shown that the star has an apparently constant radial velocity of about 5 km. On many other occasions, however,

the spectrograph gave excellent results, agreeing well among themselves and with recent determinations for the same stars made with the Bruce spectrograph. On account of the uncertain behavior of the instrument, it is impossible to base conclusions regarding the precision of our own results upon the contemporaneous observations of known stars by Messrs. Frost and Adams.

A source of error which undoubtedly affected seriously our determinations of radial velocity, giving rise to the widely different values obtained for different lines, is the physical condition of fourth-type stars. As will be shown later, the spectra of these stars differ widely from the solar spectrum, partly through marked changes in the relative intensities of the dark lines, and partly through the presence of bright lines. Both of these causes greatly complicate the determination of radial velocity, and thus introduce errors which appear later in the corrected wave-lengths.

An idea of the precision of the measures may be obtained from the following table, which gives the average deviation of the wave-length of a line in one star from the mean for six, seven, and eight stars. The number of lines used is given in parenthesis after each deviation.

PRECISION OF THE MEASURES

AVERAGE DEVIATIONS

No. of Stars	Blue Region	Yellow-Green Region	Both Regions
	t.m.	t.m.	t.m.
6	0.15 (29)	0.28 (28)	0.22 (57)
7	0.17 (22)	0.22 (24)	0.20 (46)
8	0.22 (19)	0.23 (30)	0.23 (49)
Means.........	0.18 (70)	0.25 (82)	0.22 (152)

The probable error of the mean averages 0.07 t.m.

In such a comparison it is of course assumed that the wave-length of a line does not vary from star to star. That this assumption is in some degree warranted is shown by the residuals at the foot of the following table, which contains the wave-lengths of the forty-nine dark lines measured in all of the stars, with their average deviations from the mean.[28] These results also give a final check on the adopted values of the velocities of motion in the line of sight, as the mean wave-lengths should agree if the velocities were correct. The actual residuals, ranging from -4 to $+4$ km. (mean ± 2.3 km.), show that the adopted values are not greatly in error. The stars in the table are arranged in the assumed order of development (Plate IX).

LINES MEASURED IN ALL OF THE STARS

	280 *Schj.*	19 *Pisc.*	318 *Birm.*	74 *Schj.*	78 *Schj.*	132 *Schj.*	115 *Schj.*	152 *Schj.*	Means	a. d.
	4435.22	35.52	35.49	35.72	35.92	35.60	35.47	35.97	35.61	0.19
	4501.22	01.78	01.87	01.97	01.87	01.92	00.91	02.15	01.71	0.29
	4506.38	06 77	07.08	07.04	07.09	07.12	06.74	07.24	06.93	0.22
	4512.83	12.76	12.64	12.30	13.08	12.83	13.05	12.81	12.79	0.16
	4518.15	18.27	18.31	18.38	18.53	18.35	18.21	18.23	18.31	0.09
	4522.91	23.00	23.06	23.20	23.23	23.17	23.08	23.21	23.11	0.10
	4535.30	35.84	35.84	35.90	35.70	36.04	35.56	36.21	35.67	0.24
	4560.11	60.39	60.42	60.48	60.47	60.23	60.35	60.21	60.34	0.11
	4606.26	06.87	06.86	06.88	07.20	06.83	06.24	06.38	06.69	0.27

[28] Out of 537 catalogued lines and spaces, only 49 were common to all the 8 stars. The reasons for this are as follows:

1. The appearance of any given line varied greatly with exposure time and temperature changes, so that it might be unmistakable in character on one plate and so indefinite as to be left unmeasured on another, as the choice of lines to be measured was made independently on each plate.

2. Lines marked doubtful on both plates of a star were not catalogued unless unmistakable in character in other stars.

3. Plates of the faint stars 280 *Schj.*, 74 *Schj.*, and 115 *Schj.* contained comparatively few lines, and at the same time the proportion of doubtful lines on these plates was greater than the average.

By this process of exclusion the number of lines common to all the stars was greatly reduced, though the number measured in 5 or 6 stars was much greater.

LINES MEASURED IN ALL OF THE STARS—*Continued*

	280 *Schj.*	19 *Pisc.*	318 *Birm.*	74 *Schj.*	78 *Schj.*	132 *Schj.*	115 *Schj.*	152 *Schj.*	Means	a. d.
	4617.74	17.80	18.03	17.99	18.09	18.23	17.74	18.15	17.97	0.15
	4619.29	19.68	19.86	19.70	19.85	19.56	19.42	19.40	19.60	0.19
	4638.03	38.75	39.19	39.03	39.15	39.07	38.78	38.96	38.87	0.26
	4766.78	66.11	66.47	66.33	66.55	66.47	66.98	66.54	66.50	0.18
	4822.75	23.91	23.86	23.51	24.02	23.96	23.27	23.86	23.64	0.45
	4826.52	27.81	28.21	28.23	28.31	28.19	27.88	27.90	27.88	0.46
	4832.49	32.51	32.56	32.57	32.61	32.30	32.48	32.46	32.48	0.07
	4882.07	81.69	81.55	81.75	81.71	81.53	81.09	81.52	81.61	0.19
	4900.70	00.81	00.95	01.37	01.34	00.67	01.87	01.18	01.11	0.33
	4920.65	21.03	20.78	20.97	21.00	20.52	21.23	20.54	20.84	0.22
	5226.19	26.19	26.33	26.17	26.35	27.28	26.78	26.98	26.49	0.31
	5234.33	31.27	34.22	33.95	33.97	33.91	33.99	33.44	34.01	0.20
	5247.48	47.56	47.31	47.32	47.43	47.41	47.19	47.21	47.37	0.10
	5251.30	51.44	51.28	51.66	51.47	51.46	51.83	51.31	51.47	0.15
	5270.62	70.46	70.02	70.17	70.55	70.41	70.75	70.05	70.38	0.22
	5298.16	98.19	97.77	97.70	97.63	98.11	98.37	97.40	98.00	0.20
	5315.31	15.27	15.12	15.30	15.09	15.28	15.30	15.40	15.26	0.09
	5337.05	36.94	36.83	36.65	36.86	36.82	36.97	37.30	36.93	0.14
	5341.84	41.30	41.26	41.35	41.59	41.63	41.78	41.61	41.54	0.19
	5372.07	71.70	71.50	71.52	71.68	71.89	71.64	72.10	71.76	0.19
	5377.48	77.58	77.36	77.38	77.38	77.44	77.29	77.07	77.37	0.10
	5380.54	79.82	79.72	79.91	80.47	80.46	80.68	79.91	80.19	0.35
	5397.47	97.58	96.81	97.28	96.91	97.97	96.75	97.88	97.33	0.39
	5420.44	20.17	20.22	19.66	20.53	20.43	20.49	20.13	20.26	0.21
	5430.33	30.39	30.13	29.87	30.27	30.33	30.17	30.24	30.22	0.11
	5448.31	48.09	47.72	47.94	47.62	47.73	47.54	47.06	47.75	0.28
	5456.54	56.96	56.43	56.54	56.81	56.92	56.46	57.13	56.72	0.23
	5461.13	60.99	60.84	60.49	60.96	60.99	60.80	61.18	60.92	0.16
	5475.08	74.56	74.38	74.33	74.46	74.20	74.34	74.35	74.46	0.19
	5557.27	56.32	56.28	55.80	56.38	56.30	56.36	56.24	56.37	0.23
	5567.60	66.60	66.86	66.57	67.23	66.84	67.42	68.08	67.15	0.43
	5584.65	83.98	83.70	83.98	84.02	83.86	83.83	83.69	83.96	0.19
	5587.54	86.95	86.96	86.89	87.23	86.97	87.66	87.57	87.22	0.28
	5634.05	34.21	34.11	34.20	34.23	33.79	34.58	33.76	34.12	0.24
	5645.22	44.07	43.74	43.71	44.29	43.89	45.20	44.57	44.34	0.48
	5671.71	70.83	71.44	71.26	71.34	70.99	71.68	71.22	71.31	0.23
	5694.41	93.78	93.89	93.62	93.79	93.21	94.16	93.17	93.76	0.31
	5706.71	05.41	05.42	05.25	05.05	04.53	05.14	04.97	05.31	0.29
	5731.70	31.20	31.56	31.76	31.48	30.72	31.97	31.60	31.60	0.14
	5744.32	44.35	43.89	43.96	43.02	43.60	43.73	43.26	43.77	0.37
Means..........	5150.86	50.78	50.74	50.72	50.85	50.77	50.84	50.79	50.79	0.23
Residuals t.m...	+0.07	−0.01	−0.05	−0.07	+0.06	−0.02	−0.05	.00	.....	.....
" km...	+4	−1	−3	−4	+3	−1	−3	0	±02.3	.....

THE CARBON BANDS

Since the time of Secchi the characteristic dark bands of fourth-type stars have been attributed to some form of carbon. For the reasons mentioned by Dunér,[29] the measures of Secchi, though they appear to be sufficient to identify the bands, can be given but little weight. The measures of Vogel and Dunér have therefore formed the only reliable basis of comparison. The means of these measures, compared with the wave-lengths of the heads of the carbon bands, are as follows:

Star	Carbon Bands	$\Delta\lambda$, Star−Laboratory	
t.m.	t.m.	t.m.	
437	4381.93	−10.±	Edge of violet band
4729	4737.18	− 8.	Edge of blue band
5162	5165.30	− 3.	Edge of green band
5633	5635.43	− 2.	Edge of yellow band

[29] *Loc. cit.*, p. 122.

While the differences are in some cases considerable, these measures leave no doubt that the dark bands of the fourth-type stars correspond with the bands of the Swan spectrum. The systematic shift toward the violet of the bands in the star is presumably due to a physiological effect arising from the presence of the bright zones on their less refrangible edges. The largest errors naturally correspond to the faintest bands.

As our photographs show not only the principal heads, but also the secondary heads of the flutings, a careful comparison with the carbon flutings in the electric arc seemed desirable. Photographs of the various bands, compared with photographs of the bands of the carbon arc, are reproduced in Plate VII. From these it will be seen that the fluted structure of the bands is repeated in the stars with perfect fidelity.

The following table contains the mean wave-lengths of the heads of the various flutings, as derived from all of our measures; the number of stars in which each fluting was measured; the maximum and average deviation from the mean wave-length in all of the stars measured; the assumed origin of the flutings; the wave-lengths of the flutings as measured by various investigators in the laboratory; and the differences between the star and laboratory determinations. In these last comparisons the wave-length determinations of Crew and Basquin are used for the cyanogen flutings, and those of Kayser and Runge for the flutings of the Swan spectrum.

HEADS OF THE CARBON FLUTINGS					WAVE-LENGTH IN LABORATORY					$\Delta\lambda$, STAR − LABORATORY	
Mean Wave-Length in Stars Corrected for Slit-Width	No. of Stars	Deviation from the Mean		Origin	Eder and Valenta	Fievez	Hassel-berg	Kayser and Runge	Crew and Basquin	Kayser and Runge	Crew and Basquin
		Maximum	Average								
		t.m.	t.m.		t.m.	t.m.	t.m.	t.m.	t.m.	t.m.	t.m.
4380.6	..	...	...	Swan Spec.	4380	......	......	....	....	.....	...
4503.2	5	0.5	0.2	*CN*	....	......	......	....	4502.35	.....	+0.9
4515.0	2	0.4	0.4	*CN*	....	......	......	....	4514.95	.....	0.0
4532.6	4	0.4	0.4	*CN*	....	......	......	....	4532.06	.....	+0.5
4555.3	5	0 4	0.3	*CN*	....	......	......	....	4553.31	.....	+2.0
4578.4	6	0 6	0.5	*CN*	....	......	......	....	4578.19	.....	+0.2
4608.8	6	0.6	0.3	*CN*	....	......	......	....	4606.33	.....	+2.5
4697.2	1	...	...	Swan Spec.	4697.66	......	4696.2	4697.57	....	−0.4	...
4716.5	4	(1.3)[30]	0.2	"	4715.73?	......	4713.7	4715.31	....	+1.2	...
4738.6	7	0.6	0.2	"	4737.25	4736.3	4735.7	4737.18	....	+1.4	...
[5169.1][30]	3	(1.8)[30]	0.4	"	....	5165.6	5165.4	5165.30	....	.....	...
5505.4	3	0.9	0.7	"	....	5504.6	5501.6	....	....	.....	...
5543.5	4	0.4	0.2	"	....	5543.3	5538.5	5540.86	....	+2.6	...
5587.7	3	0.2	0.1	"	....	5581.5	5586.2	5585.50	....	+2.2	...
5638.8	8	0.8	0.4	"	....	5635.0	5637.5	5635.43	....	+3.4	...
		Mean, 0.3								Mean Shift, +1.4 t.m.	

As the average deviation from the mean for a single star is only 0.3 t.m., while the mean shift of the heads of the flutings is 1.4 t.m. toward the red, there would appear to be some actual shift of the flutings in the star. The mean of Vogel's and Dunér's wave-lengths, as given above, indicates a somewhat larger shift toward the violet. It should be remembered, however, that these observations were made visually with very limited instrumental means, which did not permit a high degree of precision to be attained. Dunér's measures of the heads of the carbon flutings, for example, show the following range, which is surprisingly small, in view of the circumstances under which they were made:

132 *Schjellerup*	5640	5168	4715
132 *Schjellerup*	5634	5161	4730
152 *Schjellerup*	5625	5169	4721
152 *Schjellerup*	5635	5165	4740

[30] End of plate; too faint for precise measurement.

Our measures of these heads for the same stars are:

132 *Schjellerup*	5638.7	5169.5	4738.7
132 *Schjellerup*	5638.2	5169.0	4738.5
152 *Schjellerup*	5638.1	5169.1	4739.2
152 *Schjellerup*	5637.8	5168.6	......

It is therefore evident, as might be expected from the use of photographic methods with a much more powerful telescope, that the precision of our determinations of the positions of the flutings is considerably higher than that of Dunér's measures. But it is nevertheless unsafe to conclude that the apparent shift of the flutings in the stars is actually due to some peculiarity of their carbon radiation; for, even with all the advantages of such determinations, the differences between the wave-lengths measured in the laboratory by excellent observers are quite as great as the differences between our wave-lengths for the stars and the laboratory determinations of Kayser and Runge. The measurement of the edge of a more or less diffuse band is always liable to error. But in the fourth-type stars the difficulty of measurement is greatly increased by the presence of closely adjoining, or even overlapping, bright and dark lines. Thus the lines of the *b* group have prevented us from obtaining a satisfactory measure of the head at λ 5165. Under these circumstances we are not inclined to adopt the conclusion that the carbon flutings in the fourth-type stars are actually displaced from their normal positions.

The long discussion on the origin of the Swan spectrum, which has played so conspicuous a part in the literature of spectroscopy, cannot be said to have terminated. This is hardly an appropriate place to present the numerous arguments advanced by the supporters of the various views which are still entertained. The assignment of these bands to carbon monoxide by Smithells,[31] with its subsequent confirmation by Baly and Syers,[32] seemed for a time to set the matter at rest. But the recent work of Konen[33] has revived the discussion. Konen investigated the spectrum of the electric discharge in various liquids containing carbon, and obtained the Swan spectrum in many cases when every precaution had been taken to exclude oxygen. He is therefore inclined to the belief that the Swan spectrum is due to carbon alone, though he admits that if the discharge is very easily affected by minute quantities of oxygen, the Swan spectrum may be due to *CO*. Although Smithells apparently made out a fairly good case in assigning the bands of the Swan spectrum to carbon monoxide, we believe that the importance of the difficulties raised by Konen should not be underestimated. As he points out, the presence of considerable quantities of salts in the solution in which the discharge takes place may not suffice to bring out metallic lines, and the cyanogen bands do not appear in weak solutions of ammonia. It may be, however, that a very small amount of oxygen would act energetically, and suffice to give rise to the Swan spectrum. But the last word on this subject has not been said, and it is to be hoped that further investigations will be made on the spectra of the electric discharge in liquids.[34]

There seems to be little difference of view regarding the origin of the cyanogen bands, which we have identified in the blue part of the spectrum. These bands also appear in the spectra of stars of Secchi's third type, as may be seen from an examination of the spectra reproduced in Plate VII.

Some discussion on the probable condition of carbon in stars of the third and fourth types, as well as in the Sun, may be found on p. 128.

IDENTIFICATION OF THE DARK LINES

The following table, supplemented by remarks on the several elements identified, summarizes the results of our study of the origin of the dark lines. The numbers in the column headed "Widened in Sun-Spots" are those given by Maunder in the *Greenwich Spectroscopic and Photographic Results*

31 "On the Spectra of Carbon Compounds," *Phil. Mag.*, 6th Ser., Vol. I (1901), p. 476.

32 "On the Spectrum of Cyanogen," *Phil. Mag.*, 6th Ser., Vol. II (1901), p. 386.

33 "Ein Beitrag zur Kenntnis spectroskopischer Methoden," *Annalen der Physik*, Vol. IX (1902), p. 742.

34 The investigations by one of us on spark spectra in liquids were undertaken with a different object in view.

for 1880. The amount of widening is in tenths of the normal width; the next column gives the number of spots in which the line was widened, out of eighteen observed. In the red region the amount of widening is taken from Cortie's papers in *Monthly Notices*, Vol. XLIX, p. 410. and Vol. LXII, p. 516.

We are fortunately able to include in the table the wave-lengths of lines in the spectrum of *a Orionis*, as measured by the late Professor Keeler on photographs taken with a three-prism spectrograph at the Allegheny Observatory. These were sent to us by Professor Keeler in manuscript for the purposes of this comparison. At the Conference of Astronomers held at the Yerkes Observatory in 1897 he described his photographs of third-type spectra as follows:

> The series of slides included the spectra of *a Bootis*, *a Aurigae*, *a Tauri*, *a Orionis*, *a Scorpii*, *β Pegasi*, and *a Herculis*, in which may be observed a transition from the second to the third type. In stars like *a Orionis* the lines are essentially those of the solar spectrum, but the relative intensities are not the same, and the general aspect of the spectrum is different from that of the spectrum of the Sun. The dark bands characteristic of third-type stars are well shown, though they are not resolved into lines. The separate lines are doubtless far beyond the resolving power of the instrument. These bands are not always terminated by strong metallic lines, and the appearance noted by early observers was probably due to insufficient optical power. The strong lines are mostly those of iron—apparently the low-temperature lines. Their relatively greater strength in the star spectrum gives to some well-known solar groups (notably the *b* group) quite an unfamiliar aspect.
>
> In *a Herculis* only a comparatively few of the strong metallic lines remain, while the bands are deep, and beautifully distinct. It is impossible to avoid the conclusion that the edges of the zones bordering on the dark bands are bright—much brighter, that is, than the average continuous spectrum—and that they are due to a real predominance of emission at the regions of the spectrum in which they occur. They are not merely the effect of absorption in adjoining regions. In the case of stars like *a Orionis*, of a less pure type, such a conclusion could not be safely drawn; yet the superior brightness of the spectrum at these places is obvious, and it can be traced even in second-type stars. May there not after all be bright regions in the solar spectrum, such as Draper supposed he had found in the places of the bright oxygen lines? And what is the relation between the dark bands in third-type stars and the bright zones which border on them?

It is an interesting fact that some of the bright lines, and also some of the dark lines in fourth-type spectra, similarly lie in close proximity to dark and bright zones.

COMPARISON WITH SUN-SPOTS AND WITH THIRD-TYPE STARS

Fourth-Type Stars		Probable Origin	Widened in Sun-Spots		Remarks	Type III *a Orionis*—Keeler	
Wave-Length	Intensity		Amount of Widening	Number of Spots		Wave-Length	Intensity and Character
t.m.						t.m.	
3933	10	*Ca* (K)	No widened lines in this region		Strong lines; One-prism plate, wave-lengths uncertain by 1 t.m.		
3967	w	*Ca* (H)			See note 5		
4004.4		*Fe*, *Ti*					
4018.3		*Fe*, *Mn*					
4034.8	1	*Fe*, *Mn*					
4058.2	3	*Fe*, *Co*, *Cr*					
4078.7		*Fe*, *Ti*					
4100.5	4	*H* (*Hδ*)			See note 5		
4132.3		*Fe*					
4145.4	1	*Fe*					
4197.5							
4227.6	10	*Ca*			See note 1; Characteristic lines		
4254.4		*Cr*					
4274.0		*Fe*, *Cr*, *Ti*					
4282.8	1	*Ca*, *Fe*					
4289.0		*Ca*, *Cr*, *Ti*					
4304 to 4313					G group		
4325.9		*Fe*					
4340.4	3	*H* (*Hγ*)			See note 5		
4354.2	2						
4363.4	2	*Cr*					

COMPARISON WITH SUN-SPOTS AND WITH THIRD-TYPE STARS—*Continued*

Fourth-Type Stars		Probable Origin	Widened in Sun-Spots		Remarks	Type III α *Orionis*—Keeler	
Wave-Length	Intensity		Amount of Widening	Number of Spots		Wave-Length	Intensity and Character
t.m.						t.m.	
......							
......							
4383.7	6	*Fe, V*	No widened lines in this region		Carbon head		
4389.9	2	*V*					
4392.0	2	*Fe, Cr, V*					
4395.0	6-7	*V, Cr, Ti*					
4398.0	1-2						
4401.0	4	*Fe, V, Ni*					
4403.3	4						
4405.1	3-4	*Fe, Y*			See note 4		
4408.5	3	*Fe, V*					
4410.9	1	*Ni*					
4412.4	2	*V, Cr*					
4415.3	3	*Fe*			See note 4		
4416.7	2	*V*					
4420.6	2	*V, Zr*					
4421.7	2-3	*V, Ti*					
4423.0	2	*Fe, Ti, Y*					
4425.9	2-3	*Ca, Ti, V*					
4427.7	2-3	*Fe, Ti*			See note 4		
4430.3	2	*Fe, V*					
4433.9	1	*Fe, Ti*					
4435.6	5	*Ca, V*					
4438.2	2-3	*Fe, V*					
4444.6	2-3	*Fe, Ti, V*					
4445.7	2	*Fe*					
4447.4	2	*Fe, Mn*					
4450.1	3	*Ti, V*					
4455.3	2	*Ti, Ca, Mn*					
4456.7	0-1	*Fe, Ca*					
4458.1	1	*V, Ti, Mn*					
4462.2	4	*Fe, V, Mn*			See note 4		
4465.4	2	*Cr, Ti*					
4466.9	2	*Fe*					
4468.9	1	*V, Ti*					
4471.7	1-2	*Ti, Co*					
4475.3	1	*Ti*					
4475.6	1	*Cr*					
4480.2	1-2	*V, Fe*					
4482.3	2-3	*Fe*					
4487.5	2						
4489.7	2-3	*Fe, V, Cr*					
4497.0	4	*Ti, V, Cr*					
4501.8	2-3	*Ti, V*					
4507.0	3				Carbon head		
4509.8	1-2	*Ca*					
4512.8	2	*Ca, Ti*					
4516.2	1						
4518.3	2	*Ti*					
4520.5	1	*Fe*					
4523.1	3-4	*Ti*			Important *Ti* group		
4527.4	2	*Ca, Cr, Ti*			See note 7		
4528.7	2	*V, Fe*					
4531.3	1-2	*Fe, Cr*					
4533.4	3	*Ti*					
4535.7	4-5	*Cr, Ti*					
4540.5	2-3	*Cr*					
4542.9	2	*Fe, Cr*					
4544.9	2	*Cr, Ti*					
4549.3	4	*Fe, Ti*			See note 7		
4552.8		*Ti*					
4553.8	7	*Fe, Ti*			Carbon head		
4560.3	3-4	*Fe, Cs*			Strongest *Cs* line in Bunsen flame		
4563.5	2-3	*Cr, Ti*			See note 7		
4565.8	2	*Fe, Cr*					

COMPARISON WITH SUN-SPOTS AND WITH THIRD-TYPE STARS—*Continued*

Fourth-Type Stars		Probable Origin	Widened in Sun-Spots		Remarks		Type III α *Orionis*—Keeler	
Wave-Length	Intensity		Amount of Widening	Number of Spots			Wave-Length	Intensity and Character
t.m.							t.m.	
4571.8		*Ti, Cr*	No widened lines in this region					
4575.4	2	*Fe*						
4577.5	1-2	*V*						
4580.5	1-2	*Cr, Fe, V*						
4582.6	1	*Fe, Ca*						
4584.7	2	*Fe*						
4586.4	2	*V, Ca*						
4587.4	2	*Fe*						
4591.2	2	*Cr, V*						
4594.2	2-3	*V*						
4597.4	1-2	*Cs*						
4600.8	2	*Cr, Ni*						
4602.9	2	*Fe*						
4606.8	7	*Ni*			Carbon head 4609			
4607.5	4	*Fe, Sr*						
4610.3	1							
4611.4	2	*Fe*						
4613.9	2-3	*Cr, Fe*						
4616.4	3-4	*Cr*						
4619.5	3-4	*Fe, Cr*						
4622.9	2	*Cr, Ti*						
4628.7	1	*Cr*						
4629.7	4	*Ti, Co*						
4634.4	1							
4637.6	1	*Fe*						
4640.4	4-5	*Fe, V, Ti*						
4646.4	4	*Cr*						
4654.1	2-3	*Fe*				Dark band, continuous spectrum very faint		
4656.4	2	*Ti*						
4664.1	2	*Cr*						
4668.1	3	*Fe, Ti, Ni*						
4674.9	2-3	*Fe, Ti*						
4682.3	1-2	*Ti*						
4688.6	1	*Fe*						
4691.1	1	*Ti, Fe*						
4697.0	2	*Cr*						
4702.0	1	*Ni*						
4703.8	1	*Ni*						
4714.7	4	*Ni*						
4715.6		*Ni*			Carbon head 4716			
4722.6	1-2	*Ti, Zn*						
4729.1	1	*Fe*						
4732.5	1	*Ni*						
4736.2	10	*Fe*			Carbon head { 4738, 4744			
4740.1	1							
4743.9	10	*Fe? Ti*				Bright zone; dark lines may be obscured or displaced by bright lines		
4749.6	2							
4751.6	10	*V*			Carbon head 4754 in 152° *Schj.*			
4756.1	1	*Fe, Cr*						
4758.9	3-4	*Ti*						
4766.5	1-2	*Mn*						
4772.6	2	*V, Fe*						
4776.8	1-2	*V*						
4784.5	1-2							
4789.6	1-2	*Fe, Cr*						
4806.2	1							
4812.1	1	*Ni, Ti*						
4815.9	2							
4823.8	1-2	*Fe, Mn*						
4828.0	2							
4832.5	3-4	*Fe*						
4836.3	1							
4839.7	1	*Fe*						
4843.4	1-2	*Fe*						
4851.8	1	*Ca, V*						

COMPARISON WITH SUN-SPOTS AND WITH THIRD-TYPE STARS—*Continued*

Fourth-Type Stars: Wave-Length	Fourth-Type Stars: Intensity	Origin	Widened in Sun-Spots: Amount of Widening	Widened in Sun-Spots: Number of Spots	Remarks	Type III, α *Orionis*—Keeler: Wave-Length	Type III, α *Orionis*—Keeler: Intensity and Character
t.m.					Bright zone: dark lines may be obscured or displaced by bright line	t.m.	
4855.5	1-2	*Ni*				......	
4859.6	1	*Fe*				......	
4861.3	10	*H*, (*H*β)			Bright in 280 *Schj.* note 5	4861.5	About the same as Sun
......						4864.4	Stronger than Sun
4865.1	2	*V*				......	
4867.7	1-2	*Co*	4	7		......	
4871.5	2-3	*Fe*	6	14		4871.8	Same as Sun
4875.5	2	*V*	2	3		4875.6	Strong in star Sun?
4878.3	1	*Ca*, *Fe*	5	13		4878.3	Same as Sun
4881.6	3-4	*V*, *Fe*	6	9		4882.0	Triple, as in Sun, but stronger
4886.0	4	*Fe*, *V*	2	2		......	
4890.3	1-2	*V*				4890.9	Same as Sun
......						4891.6	
......						4900.3	Stronger than Sun
4901.1	2	*Ti*, *V*				......	
4906.4	3-4	*V*				......	
4910.3	2	*Fe*	1	4		......	
......						4919.2	Same as Sun
4920.9	2-3	*Fe*	7	13		4920.7	Same as Sun
4925.2	1	*Fe*	2-3	6		......	
......						4933.4	Somewhat stronger than Sun
4934.1	2	*Fe*, *Ba*	5-6	13		4934.3	
......						4937.5	Stronger than Sun
......						4938.8	
......						4939.9	
4945.6	1-2	*Fe*, *Ni*	4	3		......	
......						4956.0	Strong, not in Sun
4958.4	2					4957.6	Same as Sun
4981.8	w	*Fe*, *Ti*	6	10		4982 to 4984	Group, same as Sun — Edge of band. All in dark band
							34 lines not in Type IV, in dark band
5167.2	2	*Fe*, *Mg*, (b_4)	5	15	Carbon head 5164, see note 6	5167.6	Very strong, same as Sun
					Bright space	5169.2	
						5171.8	Stronger than Sun
5173.4	5	*Ti*, *Mg*, (b_2)	8-9	15	See note 6	5172.9	Same as Sun
5183.8	3	*Mg*, (b_1)	5	15		5183.8	Same as Sun
5189.2	1-2	*Ca*, *Ti*	5-6	7			
......						5191.6	Same as Sun or a little stronger
5193.3	3-4	*Fe*, *Ti*, *V*	4-5	7		5192.5	
......						5195	
5202.4	1	*Fe*	6	6			
......						5204.8	Equal lines stronger than Sun
5205.8 to 5210.1	10	*Cr*, *Fe*, *Ti*	6	12	Very strong line See notes 3, 4, and 7	5206.2	
						5208.6	Weak in Sun
						5210.6	
5216.7	2	*Fe*		4			
......						5219.6	Not in Sun
5226.5	7	*Cr*, *Fe*, *Ti*	5-6	8	See notes 3 and 4	5224 to 5227.2	Group, stronger than Sun
5234.0	3	*V*	4-5	3			
5239.8	2		2	2			
5247.4	3-4	*Cr*, *Fe*, *Ti*	1	2		5247.7	Strong, weak in Sun
5251.5	3-4	*Fe*, *Ti*	3	2	See note 4	5250.6	Stronger than Sun
......						5252.3	
5255.6	1-2	*Cr*, *Fe*	5	5		5255.1	
......						5261.1	
5265.9	1	*Ca*, *Cr*	2-3	7			
......						5269.7	Stronger than Sun
5270.4	4-5	*Ca*, *Fe*	5-6	12	*E*. See notes 2 and 4	5270.4	

COMPARISON WITH SUN-SPOTS AND WITH THIRD-TYPE STARS—*Continued*

Fourth-Type Stars		Probable Origin	Widened in Sun-Spots		Remarks	Type III *α Orionis*—Keeler	
Wave-Length	Intensity		Amount of Widening	Number of Spots		Wave-Length	Intensity and Character
t.m.						t.m.	
5283.6	1-2	*Fe*	4	5			
......						5297.0	Stronger than Sun
5298.2	3-4	*Cr, Ti*	5	5	Strong *Cr* group; see note 3	5298.0	Same as Sun
5302.5	1-2	*Fe*	5	5			
5307.5	1	*Fe*	8	1			
5315.2	2-3	*Fe*					
5320.8	2-3	*Fe*					
5325.3	1	*Co*					
						5328.5	Somewhat stronger than Sun
5329.0	3-4	*Cr, Fe*	6	3	Strong *Cr* group, note 3		
5336.9	2	*Ti*	5	6			
5341.5	3	*Fe, Mn*	3-4	6		5341.2	Stronger than Sun
......						5346.0	Stronger than Sun
......						5348.5	A little stronger than Sun
5350.0	3	*Ca, Fe*	5	6		5349	
5362.7	1	*Fe, Co*	2-3	3			
5366.6	2						
......						5370	Same as Sun
5371.7	7-8	*Fe, Cr*	6	8	See note 4	5371.6	Stronger than Sun
......						5376.0	Not in Sun
5377.4	2-3	*Fe, Mn*	8	1			
5384.7	1						
5391.1	1		4	3			
5397.3	4	*Fe, Ti*	6	6		5397.2	Stronger than Sun
......						5404	Weaker than Sun
5406.4	1	*Fe*	8	6		5406	Stronger than Sun
5408.3	2-3						
5410.4	2-3	*Cr*	5-6	5		5410.0	Stronger than Sun
......						5411.1	Same as Sun
5414.2	1-2						
5420.2	3		1	2			
......						5424.2	Same as Sun
5425.1	1	*Ni*					
......						5426.5	Not in Sun
5430.2	3	*Fe*	6	6		5429.9	Stronger than Sun
......						5433.0	Stronger than Sun
5434.3	1-2	*Fe, V*	4	5		5434.7	Stronger than Sun
......						5436	Same as Sun
5438.6	1-2	*Fe, Ti*					
......						5445.2	Same as Sun
5447.8	7	*Fe, Ti*	6	5	See note 4	5447.0	Stronger than Sun, edge of band
......						5455.7	Stronger than Sun
5456.8	2-3						
5460.9	1-2					5461.0	Not in Sun
......						5463.0	Weaker than Sun
5467.3	1-2	*Fe*	1	1			
5474.5	1-2	*Fe*	2	1			
5478.0	1-2	*Ti*	3-4	1		5477	Same as Sun
5483.0	1-2	*Fe*	3	1			
5498.0	4	*Fe*	5-6	4		5497.6	Stronger than Sun
5501.8	2	*Fe*	5	5		5501.6	Stronger than Sun
5507.1	1	*Fe*			Carbon head 5505	5507.0	Stronger than Sun
5512.4	2-3	*Fe, Ti*	5	5			
5524.3	1-2	*Fe*					
5525.4	1-2	*Fe*	6	1			
5528.6	1	*Mg*	5	6	Carbon flutings	5528.5?	Same as Sun
5533.9	1						Region here same as Sun
5539.5	7				Carbon head 5543		
5546.6	1-2	*Fe*					
5548.3	2	*V*					
5552.5	1						
5556.4	1-2						
5562.6	1	*Fe*	1	1			
5567.0	2		2	1			
5570.2	1	*Fe*					

COMPARISON WITH SUN-SPOTS AND WITH THIRD-TYPE STARS—*Continued*

FOURTH-TYPE STARS		PROBABLE ORIGIN	WIDENED IN SUN-SPOTS		REMARKS		TYPE III *α Orionis*—Keeler	
Wave-Length	Intensity		Amount of Widening	Number of Spots			Wave-Length	Intensity and Character
t.m.							t.m.	
5573.7	1							
5576.2		*Fe*						
5583.9	8				Carbon head 5587	Carbon flutings		Region here same as Sun
5589.2	1	*Ca*	1	1				
5594.7	1–2	*Ca*	4	5				
......							5598.5	Stronger than Sun
5609.1	2							
5615.7	1	*Fe*	4	4			5615.7	Same as Sun
5620.3	2 3		2	1				
5625.1	4	*V*, *Fe*	2	3	See Note 8		5624.7	Stronger than Sun
5631.0	10	*Fe*	1	1				
5644.2	1–2	*Ti*			Carbon head 5638			
5650.1	1	*Fe*						
5658.2	1–2	*V*	3	3		Bright zone, identifications uncertain	5658.5	Stronger than Sun
......							5663.0	Stronger than Sun
......							5669	
5671.3	1–2	*V*						
5675.5	2	*Ti*	2	1				Strong, diffuse band not in Sun
5676.7	1–2							
......							5682	
5696.7	1							
5708.3	2 3	*Fe*, *Ti*	1 2	3			5709.6	Stronger than Sun
5712.8	1–2		1	2			5712	Stronger than Sun
5721.3	2							
......							5727.2	Stronger than Sun
5731.6	3–4	*Fe*, *V*	3	2			5732.0	Stronger than Sun
5743.7	2	*V*						
5749.4	2							
5751.7	1		1	2				
5762.5	2	*Fe*, *Ti*						
5771.0	2	*Fe*						
5778.0	1							
5784.8	3	*Fe*						
5789.6	1							
5798.1	1	*Fe*	1	4				
5822.9	2							
5848.5	1	*Fe*						
......							5856	
......							5860	
......							5865	
......							5869	Region quite different from Sun
......							5875	
......							5882	
5891.3	10	*Na* (D)	3		Widened lines obs. by Cortie		5890.2	Stronger than Sun
......							5896.4	
......							5911	Sun?
5921.9	1		5					
5945.9	1		5					
6035		*Sr*	10					
6059.1	1	*Sr*	10					
6098.5	3		5 6					
6119.0	2		6 7		Broad B line			
6190.3	2		4 5		Broad B line			
6269.6	10	*CaO*, *V*	10		Very strong. See note 1			
6357.6	3		2 3					
6425.3	w		6 7					
6488 to 6588								

1. *Calcium* is well represented in these stars, the only contradictory evidence being the possible absence of the lines λ5260 to λ5265 (lines but slightly broadened in Sun-spots), which are probably obscured or displaced by emission spectrum. The line λ4226.9 is nearly as strong as H and K, suggesting a low temperature. The

strong flame lines at λ6183 and λ6202 fall on bright lines, but the very strong star line at λ6270 may include the flame line at λ6265, attributed by Eder to *CaO*.

2. The group at λ5270 consists of two strong *Fe* lines and one strong *Ca* line. In the arc, with iron or carbon poles, the two iron lines are of equal intensity, but they are so different in the spark that the arc intensity (relative to the spark line as unity) is 0.9 for the line λ5269.7 and 5 for λ5270.5. When titanium carbide (85 per cent. *Ti*) was placed on the lower carbon of the arc lamp, with four times the original exposure the line λ5269.7 kept its intensity, while λ5270.5 dropped to one-third. The wave-length of the center of the strong star line corresponds with the *Fe* line, which is strengthened in the arc, but weakened in the presence of *Ti*. This is also the wave-length of the *Ca* line.

3. *Chromium.*—The chromium lines in the region λ4400 to λ4900 are relatively weak in the arc and not represented by strong star lines. On the other hand, in the region λ5100 to λ5700 the most prominent chromium lines are relatively very strong in the arc, are usually widened in Sun-spots, and are represented by strong star lines. For example, the group λ5204 to λ5208 coincides very nearly with one of the most intense star lines outside the carbon flutings. The chromium line at λ5225.1 seems to form with the iron lines at λ5227, the strong star line λ5224.4 to 5228.6. The groups λ5296 to λ5298 and λ5328 to λ5329 coincide closely with strong star lines. The principal item of contradictory evidence is the lack of a star line to match the chromium group λ5275 to λ5276, but it will be noticed that this group is but slightly widened in Sun-spots.

4. *Iron* is doubtless present in the star, but represented by comparatively weak lines. The principal cases in the blue region where the star lines are strong are λλ4405, 4415, 4427, 4462. In the yellow-green region numerous *Fe* lines, strong in the arc and broadened in Sun-spots, correspond with strong star lines; for example: associated with *Ti* at λλ5251, 5370, 5447; with *Cr* and *Ti* at λλ5208, 5227; and with *Ca* at λ5270.

5. *Hydrogen.*—Of the hydrogen lines $H\beta$ is present as a strong bright line in some plates of 280 *Schjellerup* and absent in others, but never appears as a dark line. $H\gamma$ is present and $H\delta$ prominent in the violet plates of 19 *Piscium* as dark lines.

6. *Magnesium.*—The *b* group is a prominent feature of the spectrum, and numerous other lines are present.

7. *Titanium.*—The group λ4512 to λ4536 gives striking evidence of the presence of titanium in the star. Of the eleven lines, ten are strong in the arc and represented in the star, while the line λ4534.2 alone is weak in the arc and absent in the star. For remarks on the behavior of the lines of this group in other stellar types, see p. 134. In the yellow region the titanium lines which are strong in the arc and much widened in Sun-spots are represented by strong star lines; for example, the line λ5210.6, which according to Cortie[35] was the most widened line between D and *b* in the spot of May, 1901, is the strongest star line, and no line which is missing in the star has an intensity greater than 1 in the arc, or a widening greater than 4 in Sun-spots.

8. *Vanadium.*—The presence of vanadium seems well attested. The triplet at λ5624–5628 is especially remarkable, as it is very strong in the arc and coincides closely with the strong star line whose limits in the best plates are λ5623-5628. In the vanadium arc used the vanadium lines are weak in the region λ5100 to λ5500, and strong in the region λ5500 to λ5900. These strong lines are well represented in the star or obscured by the bright lines and zones. In general the vanadium lines which are missing in the star are weak in the arc.

No vanadium lines are identified as among those widened in Sun-spots by Maunder in the *Greenwich Results* for 1880. Photographs taken at the Yerkes Observatory show numerous vanadium lines widened, and it is now well known that vanadium lines are very characteristic of Sun-spots.

LINES WIDENED IN SUN-SPOTS

The agreement of the fourth-type with Sun-spot spectra is especially noticeable in the region λ5160–5500. The numerous lines in the region λ5500–5700 which are widened in Sun-spots are masked in the stars by the carbon flutings, so that but few coincidences are found. Taking the data from the *Greenwich Results* for 1880, the forty-six lines which are most strongly and frequently widened in the spots are found to be the most prominent dark lines in the star. They are identified as follows:

Fe -	22 lines	*Mg* - - - - -	3 lines
Ti - - - -	9 lines	*Ca* - - - - -	2 lines
V - - -	5 lines	*Mn* - - - - -	1 line
Cr - - - -	4 lines		

[35] *Monthly Notices*, Vol. LXII, p. 516.

TITANIUM

A comparison of Hasselberg's list in the region λ 5186–5823 gives the following results:

Lines Found in the Stars		Lines Not Found in the Stars
Widened in spots......................23	Not widened.....................4	Widened............................9
Mean number of spots.................4		Not widened........................41
Mean widening.........................5		
Mean intensity in star.................3		

It is unfortunate that a similar comparison cannot be given for vanadium. Maunder does not give wave-length determinations, and his tables of vanadium lines were apparently inadequate for the identification of the fainter lines, which are frequently greatly widened in spots.

The following table contains Young's observations of lines widened in Sun-spots, compared with the fourth-type lines:

YOUNG'S LINES WIDENED IN SUN-SPOTS

Wave-Length Reduced to Rowland's Scale	Amt. Wid.	Wave-Length and Character in Star (Dark line unless otherwise stated)	Wave-Length Reduced to Rowland's Scale	Amt. Wid.	Wave-Length and Character in Star (Dark line unless otherwise stated)
5191.5	2	B? lines	5424.7	3	25.1
5192.7	2	B? lines	5429.9	3	30.2
5198.9	3	B? lines	5434.1	4	34.3
5202.5	2	02.4	5447.0	4	46 to 49
5204.7	4	04.6 to 11.5	5455.8	3	56.77, shifted by B at 53.8
5208.6	4		5487.9	3	B 86.5
5227.2	2	24.1 to 28.6	5497.7	2	98.0
5230.0	2		5501.6	2	01.8
5233.1	2		5532.7	2	Carbon fluting
5266.8	2		5572.8	2	
5269.5	3	69 to 71	5584.8	1	83.9; strong, limits 81.9 to 85.9
5270.5	3		5586.6	3	
5328.1	2		5592.3	2	
5328.3			5598.3	2	B zone
5340.2	2		5602.9	2	
5341.2	2	41.5	5615.7	3	15.7
5353.5	2		5624.2	2	18.6 to 26.2
5370.1	1	70.1 to 73.7	5662.7	4	B zone
5371.6	4		5706.3	4	
5397.2	7	97.3 w	6065.7	3	59 w
5404.2	4	06.4	6136.8	3	
5405.9	4		6191.7	2	90, narrow, between two B lines
5415.6	3	14.2	6358.9		

Young's list contains forty-six widened lines between λ 5167 and λ 6357. Of these twenty-five appear in the star (53 per cent.), while twelve are obscured by bright lines. In the region best photographed and most favorable for identification, λ 5167 to λ 5531, Young has thirty-three widened lines, of which twenty appear in the star (60 per cent.) and three are obscured by bright lines.

IDENTIFICATION OF THE BRIGHT LINES

We have met with little success in attempting to identify the bright lines in fourth-type spectra. If numerous Sun-spots exist on these stars, it might be expected that violent eruptive phenomena would accompany them, and perhaps be recognizable spectroscopically. But a careful comparison with the chromospheric lines has given no evidence of genuine coincidences, except in the case of $H\beta$, which is bright in a few of the fourth-type stars. Comparisons with the spectra of nebulæ, the aurora, various terrestrial gases, etc., have resulted similarly. Only in the case of the Wolf-Rayet stars is there any evidence of a common origin, and here it is too insecure to have much weight. The following table contains the results of a comparison of some of the Wolf-Rayet lines, as measured by Campbell,[36] with bright lines in fourth-type spectra.

[36] *Astronomy and Astrophysics*, Vol. XIII (1894), p. 448.

In examining this evidence it should be borne in mind that the "very bright" (++) Wolf-Rayet lines λλ 4442, 4688, and the "bright" (+) lines λλ 4480, 4504, 4626, 4636, are certainly absent from fourth-type spectra. It will be noticed that these include Rydberg's principal series hydrogen line at λ 4688, which is one of the most conspicuous and characteristic lines of the Wolf-Rayet stars. In some of them, however, it is inconspicuous, and in *SDM.*−11°4593 it is not observable visually, though shown on Campbell's photographs. λ 4442 is very bright in many of the Wolf-Rayet stars, but in some of them it was neither seen nor photographed. From the range of Campbell's measures it seems quite improbable that the Wolf-Rayet line λ 4466 can coincide with the fourth-type line λ 4464.0. The Wolf-Rayet line λ 4473 is presumably the helium line λ 4471.7; hence it probably

Fourth-Type Stars				Wolf-Rayet Stars—Campbell				
Wave-Length		Intensity	No. Stars	Wave-Length		Intensity	No. Stars	Remarks
Mean	Range			Mean	Range			
4464.0	63.8–64.1	4 5	7	4466	65–67	+	4	
4473.6	73.6–73.6	4	2	4473	73–74	+	2 (Dark in 3)	Helium line λ 4471.7
4508.6	08.2–08.7	4	4	4509	04–10	++	4 (Dark in 1)	Blend of λ 4504 with λ 4517
4517.3	17.1–17.7	2	5	4517	15–18	+	4	
4539.0	38.7–39.2	3	6	4541	34–44	++	21	Second series *H* line λ 4542.0
4596.1	95.8–96.2	4	7	4596	92–98	....	5	
4615.1	15.0–15.2	5	6	4615	14–16	....	4	
4653.0	52.8–53.1	3	3	4652	50–54	++	14	
4861.3	60.7–61.5	2–9	4	4862	.....	++	21	*H*β
5412.4	12.3–12.6	2	5	5412	10–16	++	24	Second series *H* line
5472.3	71.8–72.4	3 4	6	5472	69–74	+	13	
5592.4	91.8–93.2	2–3	7	5593	90–96	+	15	
5693.8	93.2–94.4	6	8	5693	90–95	++	18	Sharp in *DM.*+30° 3639, where wave-length is 5694.0

does not correspond with the fourth-type line λ 4473.6. The Wolf-Rayet line λ 4541 is undoubtedly a line of the second series of hydrogen; the mean wave-length of this line, as determined by Messrs. Frost and Adams on ten plates of four *Orion* stars, is 4542.0; hence it does not correspond with the fourth-type line λ 4539.0. This fact, together with the absence of the λ 4688 line of the principal series, makes it improbable that the agreement of the fourth-type line λ 5412.46 with the second series hydrogen line λ 5412 can have any meaning. On account of the well-known relationship between Wolf-Rayet and *Orion* type stars, it may be that the Wolf-Rayet lines λλ 4596, 4615, 4652 correspond with the oxygen and nitrogen lines λλ 4596.29 (*O*), 4614.0 (*N*), 4650.9 (*O*).[37] This would admit of the presence of the first of these lines in fourth-type stars, but would exclude the second and third. In this connection it should be added that oxygen and nitrogen lines (not present in Wolf-Rayet stars) may possibly coincide with fourth-type lines as follows:

Oxygen and Nitrogen	Fourth-Type Stars		
Wave-Length (Frost and Adams)	Wave-Length	Intensity	No. Stars
4591.07 (*O*)	4590.3	3	3
4621.55 (*N*)	4621.5	5–6	5
4630.7 (*N*)	4631.2	4	5
4638.94 (*O*)	4638.9	4	8
4641.89 (*O*)	4642.1	4	6
4661.73 (*O*)	4660.6	2 3	3

In the first case the agreement is not satisfactory; in the last the line is so broad in the stars that it might include the oxygen line. The other four lines are conspicuous in most of the stars, and the close agreement of wave-lengths may perhaps be significant. It should be remarked, however, that many of the most prominent lines of oxygen and nitrogen do not appear among the fourth-type lines.

[37] Wave-lengths of Frost and Adams; identifications of Neovius.

With further reference to the Wolf-Rayet stars, it may be said that the generally broad and diffuse character of the lines, while it undoubtedly complicates the comparison by rendering the measures less accurate, may not preclude coincidence, in some cases at least, with the narrower fourth-type lines; for Campbell states[38] that in the Wolf-Rayet star *D.M.* +30°3639 the lines are better defined than in any of the other spectra, and that λ 5694 is so sharp that it appears to be monochromatic. The close agreement of the wave-length of this line, determined from a long series of measures of this star made by Campbell, with that of the very strong and characteristic fourth-type line λ 5693.8 suggests a common origin.

Since $H\gamma$ and $H\delta$ have been found with the two-foot reflector to be present as very prominent dark lines in the spectrum of 19 *Piscium*, while $H\beta$ is present as a strong bright line in 280 *Schjellerup*, it becomes a matter of great interest to determine the character of the $H\beta$ line in the spectra of other stars of the fourth type. From an examination of the catalogue of lines (see line No. 278, p. 100) it will be seen that $H\beta$ appears to be absent from the spectra of 19 *Piscium*, 318 *Birmingham*, 78 *Schjellerup*, and 132 *Schjellerup*, while it is recorded as follows in the spectra of four stars:

Star	Intensity	Character	Wave-Length
280 *Schjellerup*	9	B	4861.4
78 *Schjellerup*	2	nn B	4861.5
115 *Schjellerup*	"Max"	B	4861.5
152 *Schjellerup*	1–2	n B??	4860.7

Hitherto the presence of dark $H\delta$ and $H\gamma$ lines in the spectra of fourth-type stars has been proved only in the case of 19 *Piscium*.[39] In the spectrum of this star $H\beta$ is very faint or absent. Thus the condition of hydrogen in this star (and presumably in others of the fourth type) resembles its condition in the Wolf-Rayet stars, where the ultra-violet lines of this gas are dark, while some of the less refrangible lines are absent or bright.[40]

We would base no final conclusion on the data now available, but we believe that the slender evidence of similarity of spectra here presented, together with the collateral evidence afforded by the peculiarity of the hydrogen radiation in both types of stars, and their tendency to cluster in the Milky Way, should lead to a thorough investigation of the bright lines in the future. Some discussion of the bearing of these matters on stellar evolution and the classification of stellar spectra may be found elsewhere.[41]

The bright $H\beta$ line in 280 *Schjellerup* seems to vary in intensity. The following photographs are available to test the question, and seem to leave no doubt regarding the fact, though the dispersion of the one-prism plates is insufficient to show minor changes:

INTENSITY OF THE BRIGHT $H\beta$ LINE IN 280 *SCHJELLERUP*

Plate No.	Date			Intensity	Plate No.	Date			Intensity
	y.	m.	d.			y.	m.	d.	
G 202	1898	6	3	Not shown	346	1899	10	18	10
234		9	7	10	360		12	21	Not shown
245		10	26	Not shown	366		12	28	" "
246		10 / 11	31 / 1	" "	367		12	29	" "
					370	1900	1	2	" "
274	1899	1	14	" "	385		2	15	" "
345		10	12	" "	388		2	25	" "

Pickering states that the $H\beta$ line is of variable intensity in the spectrum of the star *A.G.C.* 9181.[42]

[38] *Loc. cit.*, p. 461.

[39] With existing instruments the experiment of photographing the violet region of the spectrum of 280 *Schjellerup* (in which $H\beta$ is sometimes bright) would be rendered extremely difficult by the faintness of this star.

[40] See p. 130.

[41] See p. 134.

[42] *Astrophysical Journal*, Vol. VII (1898), p. 139.

VARIABILITY OF FOURTH-TYPE STARS

There are 237 stars of this type included in Espin's *Revised Catalogue of the Stars of the IV Type*,[43] published in 1898. Of this number twenty-eight are recognized as variable in Chandler's *Third Catalogue*, and twenty more are included in the supplement issued in 1901 by the committee of the Astronomische Gesellschaft.[44] The total, forty-eight, is 20 per cent. of the whole number. The amount of variation, as given by the above catalogues, averages 2.4 magnitudes for forty-one stars. The range of variation is distributed as follows:

Range	Number of Stars	Percentage	
		Type IV	All Stars
Less than 1 mag.	1	2	..
1 mag. and less than 2	13	32	18
2 mag. and less than 3	12	29	6
3 mag. and less than 4	7	17	9
4 mag. and less than 5	5	12	50
5 mag. and greater	3	7	18
	41		137

Column two gives the number and column three the percentage of stars having each range, and the last column gives corresponding percentages from Chandler's table[45] for all the variables well determined in his *First Catalogue*. In comparing the two columns of percentages, it should be remembered that Chandler's stars include the short-period variables, of small range, giving a maximum to the curve at a range between 1 and 2 magnitudes; but none of these short-period stars are of Type IV. Leaving these out of consideration, the maximum range for variables in general is about 4 or 5 magnitudes, but for Type IV the maximum range is about 2 magnitudes.

It now becomes interesting to consider the proportion of variables among stars of Types III and IV, as shown in the following table:

List	Number of Stars	Number of Variables	Percentage	Types
Espin[46]	237	48	20	IV
Dunér[47]	297	45	15	III
Frost-Scheiner[48]	1,217	125	10	III and IV

The above tables are necessarily incomplete, and it is probable that the number of variables in each class will be increased as observations are multiplied. But, as they stand, the tables are fairly comparable, and show that the tendency to variability is somewhat greater in stars of Type IV than in those of Type III.

DISTRIBUTION OF FOURTH-TYPE STARS

The distribution of 242 stars of the fourth type with respect to the Milky Way was investigated by Mr. Parkhurst in 1898 and the results were presented at the Second Conference of Astronomers in August of that year. In 1899 Rev. T. E. Espin published in the *Astrophysical Journal* (Vol. X, p. 169) the results of a similar count of 224 stars, showing close agreement with Mr. Parkhurst's count. Both show that the distribution in north and south galactic latitude is quite similar, and that the stars are scattered quite evenly in the zone of latitudes greater than 30°. The following table gives the results found by Espin and Parkhurst, also the distribution of 9676 *Durchmusterung* stars of magni-

[43] *Monthly Notices*, Vol. LVIII (1898), p. 443.

[44] *Astronomical Journal*, Vol. XXII, p. 77.

[45] *Ibid.*, Vol. IX, p. 2.

[46] *Loc. cit.*, p. 444.

[47] "Sur les étoiles à spectres de la troisième classe," p. 15.

[48] *Astronomical Spectroscopy*, p. 402.

tudes 6.5 to 9.5, from Seeliger's count in the second Munich catalogue. The "Density" column gives the number per unit area (the sphere being taken as unity); the column "Condensation" gives for each zone the ratio of its density to the density in the zone >30°.

Zone	Number of Stars		Density		Condensation		
Galactic Lat.	Espin	Parkhurst	Espin	Parkhurst	Espin	Parkhurst	*DM.* Stars
0°–5° } 5–10	123	92 46	708	1,060 532	11.4	18.3 9.2	2.7 2.6
10–20	43	58	256	345	4.0	6.0	2.1
20°–30°	27	17	171	108	3.0	1.9	1.5
>30°	31	29	62	58	1.0	1.0	1.0
Total	224	242					

PHYSICAL CONDITION OF FOURTH-TYPE STARS

The results described in the foregoing pages enable us to draw certain conclusions regarding the physical and chemical condition of fourth-type stars. It has long been assumed, perhaps on insufficient grounds, that the red color of these stars, indicating great general absorption in their atmospheres, might be considered as an index to a temperature lower than that of the Sun. Although we have been able, by giving a very prolonged exposure, to photograph the H and K lines in the spectrum of 19 *Piscium*, the faintness of this region in fourth-type spectra is so great that with ordinary exposures no trace of it is shown. With this marked increase of general absorption we also find evidence of increased selective absorption. This is most conspicuous in the case of the carbon bands[49] and the violet cyanogen band, which are wholly absent from the solar spectrum. The metallic lines are also in many cases much stronger than in the solar spectrum. These changes of intensity, for the most part, are such as would probably result from the cooling of a star like the Sun, especially if such cooling were accompanied by the development of extensive Sun-spots.

Let us now inquire more closely into the physical constitution of the fourth-type stars, at first with special reference to the level in their atmospheres at which the carbon absorption occurs. It is fortunately possible to answer this question with some definiteness, in view of certain observations of the carbon bands in the solar chromosphere made by one of us.[50] According to Lockyer's early view, the carbon flutings in the solar spectrum were due to the absorption of carbon vapor in the corona, at some distance above the chromosphere.[51] The large solar image given by the forty-inch Yerkes refractor permitted a test of this question to be made in 1897. With excellent atmospheric conditions and a very narrow tangential slit the numerous fine lines which constitute the green carbon fluting were seen to be bright at the very base of the chromosphere. As the least displacement of the instrument caused the lines to disappear, it was evident that the layer of carbon vapor is very thin, probably not exceeding a single second of arc in thickness. Subsequently, under exceptionally favorable conditions, seven lines in the yellow carbon fluting were seen as bright lines in the chromosphere. At the eclipse of January 22, 1898, the arcs corresponding to the heads of the cyanogen fluting at λ3883 were among the shortest photographed in the flash spectrum.[52]

The probability thus derived from solar observations that the carbon vapor in fourth-type stars lies in close contact with the photosphere is strengthened by the fact that several of the bright lines in fourth-type spectra are superposed upon the carbon flutings. It would thus appear that the unknown gases which produce these bright lines rise above the low-lying carbon vapor, just as hydrogen, helium,

[49] Throughout this discussion the bands or flutings of the Swan spectrum are referred to for convenience as the "carbon" bands. These may be due to some compound of carbon: presumably, if this is the case, to carbon monoxide (see p. 116).

[50] GEORGE E. HALE, "On the Presence of Carbon in the Chromosphere," *Astrophysical Journal*, Vol. VI (1897), p. 412; Vol. X (1899), p. 287.

[51] *Proc. Roy. Soc.*, Vol. XXVII, p. 308.

[52] LOCKYER, "Total Eclipse of the Sun, January 22, 1898. Observations at Viziadrug," *Phil. Trans.*, Vol. CXCVII (1901), p. 205.

and calcium do in the solar chromosphere and prominences. We also find that many of the dark lines of iron and other elements are absent from fourth-type spectra, their places being covered by overlapping bright lines. Thus again, as in the case of the Sun, we have evidence that carbon in some form is associated with low-lying metallic vapors, above which rise the gases whose radiations reach us without reversal.

It is a curious fact, perhaps not without significance, that the cyanogen flutings beginning at $\lambda 4609$ in fourth-type spectra do not appear to increase in strength from star to star, in harmony with the increase of intensity observed in the case of the carbon bands (see Plate VIII). This is the more remarkable when it is remembered that the cyanogen absorption in these stars is much stronger than in the case of the Sun, where these violet flutings appear to be entirely absent. For some reason the maximum intensity of these flutings seems to have been attained in so slightly developed a fourth-type star as 280 *Schjellerup*. In this connection the presence of these flutings in third-type stars, as indicated in Fig. 3, Plate VII, is of interest, particularly in view of the fact that the carbon (Swan spectrum) flutings seem to be absent from stars of the third type.

Further evidence of increased absorption, and possibly of decreased temperature, is afforded by the behavior of the metallic lines in fourth-type stars. Calcium offers an interesting case. It is well known that in the laboratory the line at $\lambda 4227$ increases in relative strength as the temperature of the calcium vapor falls, and also, according to Huggins, as the density of the calcium vapor increases. In the Bunsen burner this is a conspicuous line, while H and K are absent. The great strength of this line in the spectrum of 19 *Piscium* (Fig. 2, Plate XI) should afford a valuable criterion as to the physical condition of these stars.[53] It should be noted in this connection, as the figure indicates, that this line is equally strong in the spectra of third-type stars. The very strong and broad line at $\lambda 6270$ in the spectrum of 152 *Schjellerup* may possibly coincide with the strong line in the flame spectrum ascribed by Eder and Valenta to calcium oxide.

The tables of identifications contain more evidence of the same character. Perhaps the most interesting case of this kind is the variation of the relative intensities of the titanium lines in the group $\lambda 4534$–4536, referred to more particularly below in connection with the question of the classification of fourth-type stars.[54] The lines of this group are strongly developed in fourth-type spectra, with the exception of $\lambda 4534.14$, which is the only line of the group present in the spectra of the early *Orion* stars. This is an "enhanced" line, which in the spark spectrum is greatly reduced in intensity when the self-induction of the secondary circuit is increased. The changes in this group may be due to electrical rather than to thermal causes, but they at least harmonize with what might be expected to result from a reduction of temperature.

The possibility that spots like those on the Sun may form a characteristic feature of fourth-type stars is strongly suggested by the evidence which we have accumulated (p. 123). It is hardly necessary to say, however, that much more evidence in this direction is needed. In view of the ease with which Sun-spot spectra may be observed with instruments of moderate size, our knowledge of the widened lines is surprisingly meager. Much systematic work on spot spectra must therefore be done before the data desired for a thorough study of the question will become available. If the lines widened in Sun-spots are to be regarded as characteristic of fourth-type stars, they seem to be equally characteristic of stars of the third type. This fact will permit a rigorous test of the identification of the lines to be made, since several stars bright enough to be photographed with very high dispersion occur among the stars of the third type. It is hoped that the investigations now in progress at the Yerkes Observatory on the spectra of Sun-spots, and those which may soon be undertaken here with a cœlostat reflecting telescope and concave grating spectrograph on the spectra of a few of the brightest third-type stars, may permit a final decision to be reached regarding the presence of the

53 It is hoped that experiments in progress at the Yerkes Observatory may permit the effects of temperature to be distinguished from those of density.

54 See p. 134.

widened lines in the spectra of red stars. Sun-spots are presumably to be associated with a late rather than an early stage of solar development, and there is reason to suppose that they may grow more numerous as the Sun continues to cool. On *a priori* grounds, therefore, they might well be expected to be prominent features of red stars. The strong tendency of these stars to variability, which is even more pronounced in the case of fourth-type than in that of third-type stars, certainly does not lessen the probability that numerous Sun-spots are present.

The bright lines, of whose existence in fourth-type spectra we have given ample evidence, have offered difficulties of identification which we have hitherto been unable to overcome. It is a curious fact that the bright lines of the Wolf-Rayet stars, most of which have also proved impossible to identify, seem to agree in some cases with the bright lines of fourth-type spectra. From the detailed comparisons which are given elsewhere (p. 125) it will be seen that the evidence is by no means conclusive. The positions of the lines are not yet known with sufficient accuracy, and in any event the number of apparent coincidences is too small to have much meaning. In the course of this comparison, however, we could not fail to take into consideration the fact that the Wolf-Rayet and fourth-type stars possess in common a peculiarity which is shared by few other objects in the heavens, namely, the presence in their spectra of both bright and dark hydrogen lines.[55]

In a study of the spark discharge in liquids and in compressed gases[56] it has been found that as the conditions become more and more favorable to absorption—for example, as the pressure of the gas is increased—the reversals, which appear first in the ultra-violet, advance gradually into the visible spectrum. This dependence of selective absorption upon wave-length harmonizes completely with the earlier experiments of Liveing and Dewar, who obtained similar results with the electric furnace.[57]

In the Sun, although the entire series of hydrogen lines has been observed in the chromosphere, only the less refrangible members appear among the Fraunhofer lines. In this case we have a partial inversion of the phenomenon observed in Wolf-Rayet and fourth-type stars: the more refrangible members of the series are absent, while dark lines are present at the less refrangible end.

Kayser has proposed an explanation of such phenomena as a direct consequence of Kirchhoff's law. If the coefficient of absorption were identical for all spectral lines, the reversals should begin in the ultra-violet and advance toward the red. In the series lines of hydrogen, as represented in the Sun, the coefficient of absorption decreases so rapidly with the wave-length that the strong lines in the visible spectrum reverse first. The reversals should be strongest near the wave-length of maximum energy for the absorbing body.[58] As compared with the Sun, the Wolf-Rayet stars should therefore show a shift of the maximum of intensity in the hydrogen spectrum toward the violet.

It is fortunately possible to test this assumption, as Campbell has shown that the Wolf-Rayet star *DM.* + 30°3639 has an extensive hydrogen atmosphere, the bright lines of which can be observed directly. Campbell, indeed, found that in this case $H\alpha$ is very faint, while $H\gamma$ is brighter and $H\beta$ is very bright indeed.

Langenbach has recently shown that the maximum of intensity in a line spectrum shifts toward the violet with increasing temperature, just as it does in the case of a continuous spectrum from a solid body. Thus with hydrogen an increase of current strength through the primary of the induction coil increased the intensity of the $H\alpha$, $H\beta$, and $H\gamma$ lines, but the increase was most rapid for the more refrangible of these lines. Similar results were found for lithium and helium.[59]

Langenbach concludes that his experiments indicate a very high temperature for the nebulæ, where a similar shift of the maximum has been observed. Such a conclusion might perhaps apply to the Wolf-Rayet stars, but it would be out of harmony with what we know regarding stars of

[55] The bearing of this fact on the classification of stellar spectra is discussed on p. 134.

[56] GEORGE E. HALE, "Note on the Spark Spectrum of Iron in Liquids and in Air at High Pressures," *Astrophysical Journal*, Vol. XV (1902), p. 132; GEORGE E. HALE, "Selective Absorption as a Function of Wave-Length," *ibid.*, p. 227; GEORGE E. HALE AND N. A. KENT, "Second Note on the Spark Spectrum of Iron in Liquids and Compressed Gases," *ibid.*, Vol. XVII (1903), p. 154.

[57] *Proc. Cambridge Phil. Soc.*, Vol. IV (1882), p. 256.

[58] *Astrophysical Journal*, Vol. XIV (1901), p. 313.

[59] *Annalen der Physik* (4), Vol. X, p. 789.

the fourth type. Pickering states that in a photograph of the spectrum of a meteor $H\delta$ is the most intense of the hydrogen lines.[60] But would it be safe to conclude that the hydrogen in the meteor was hotter than the hydrogen in the Sun? In such a star as γ *Cassiopeiae*, where the temperature may be considerably higher than in the Sun, $H\beta$ is more intense than any of the other lines. But in certain variable stars of long period, which are generally supposed to be cooler than the Sun, $H\gamma$ is the strongest hydrogen line.[60]

In the case of the nebulæ, meteor, and third-type variables, Thomson's observation of the spectrum of hydrogen in a vacuum tube, separated into two parts by an aluminium partition, may perhaps be significant. He found that $H\alpha$ was brighter than $H\beta$ at the positive pole, while at the negative pole the relative intensities of the two lines were reversed.[61] Although Kirchhoff's law could not be supposed to hold for a gas radiating in this way, a shift of the maximum thus produced might perhaps cause the effects observed in the case of the fourth-type stars. We believe that since much evidence favors the view that the fourth-type stars are cooler instead of hotter than the Sun, a further study of the whole subject must be made.[62]

CLASSIFICATION AND EVOLUTION OF FOURTH-TYPE STARS

Although we have investigated in detail the spectra of but eight stars, our collection of photographs comprises the spectra of the following stars of the fourth type: 7 *Schjellerup*, *DM.*+57° 702, 27*a Schj.*, 41 *Schj.*, 51 *Schj.*, 72 *Schj.*, 74 *Schj.*, 78 *Schj.*, 115 *Schj.*, 318 *Birmingham*, 132 *Schj.*, 152 *Schj.*, 155*b Schj.*, 458 *Birm.*, 219 *Schj.*, 229 *Schj.*, 509 *Birm.*, 521 *Birm.*, 541 *Birm.*, 238 *Schj.*, 249*a Schj.*, 251 *Schj.*, 280 *Schj.*, 19 *Piscium*. All of these spectra have been used in a study of the classification and evolution of fourth-type stars. This inquiry divides naturally into two parts: (1) the development of these stars, as shown by changes in their spectra; (2) their relationship to other stars and their place in a general scheme of classification.

The criteria which we employed in arranging the stars in a series were the changes of the intensity of the carbon bands and of various groups of lines. The several series obtained independently by means of the different criteria in general agreed very well, though the peculiarities of certain lines sometimes changed the order somewhat in a few cases. The average series, based upon all the criteria, is illustrated in Plates VIII and IX. From these plates it will be seen that the spectra naturally fall into three divisions: (1), represented in the plates by the spectrum of 280 *Schj.*, includes also 541 *Birm.*; (2), represented in the plates by 19 *Pisc.*, 318 *Birm.*, 74 *Schj.*, 78 *Schj.*, 132 *Schj.*, and 115 *Schj.*, includes also 7 *Schj.*, 229 *Schj.*, 249*a Schj.*, 51 *Schj.*, 219 *Schj.*, 251 *Schj.*, 238 *Schj.*, 72 *Schj.*, and 458 *Birm.*; (3), represented in the plates by 152 *Schj.* and 155*b Schj.*, includes also 41 *Schj.*, 521 *Birm.*, 509 *Birm.*, 27*a Schj.*, and *DM.*+57° 702. It will be seen that the second division contains a large proportion of the stars. Within this division the order of arrangement is somewhat uncertain, as the differences among the spectra are so inconspicuous that they are frequently offset by such effects as may arise from differences of slit-width, exposure time, development, etc. The approximate order in this division is indicated by the foregoing enumeration of the stars which comprise it. Many of these are so nearly alike that their relative places in the series cannot be certainly determined from available data.[63]

[60] *Harvard College Observatory Circular*, No. 20.

[61] *Proc. Roy. Soc.*, Vol. LVIII (1895), p. 255.

[62] We are informed by Professor Schuster that he has worked out a new explanation of the simultaneous presence of bright and dark lines in stellar spectra, which will soon be published. It is hoped that the solar work now in progress at the Yerkes Observatory may also throw some light on this question. We reserve a detailed discussion until certain experiments are completed.

[63] To indicate the character of some of the changes which occur in passing through the series of stars, the following lines are noted as peculiar to 152 *Schj.* and other stars in the third division:

1. *Blue region.*—The strong dark line λ 4751.6, which shades off toward the violet and appears like a fluting, is found only in 152 *Schj.* No high dispersion photographs were made for other stars of the third division.

2. *Yellow-green region:*

Bright line at λ 5236.2, intensity 10; this line has intensity 6 in 115 *Schj.*, and is present, though less conspicuous, in the other stars.

Bright line at λ 5508.3, intensity 5–6; this line has intensity 2–3 in 74, 78, and 132 *Schj.*

Bright line at λ 5591.4, intensity 10. The most conspicuous bright line in the spectrum. It is near the brightest part of a carbon fluting; the other stars show a group of bright lines here whose combined intensity is very much less than that of the line in 152 *Schj.*

According to Dunér, the relative intensities of the carbon bands are not the same in all of these stars: in 19 *Piscium* the yellow band is much fainter than the other principal bands, while in 152 *Schjellerup* it is as strong as the blue band and nearly as strong as the green band. As our spectra were photographed in sections, we are not in a position to discuss this question, and we shall not undertake to do so. We can only say that our plates show nothing capricious about the behavior of the bands, as the stars occupy practically the same order in the series whether they be arranged with reference to the intensity of the blue or that of the yellow band. It therefore might appear that the absorption of carbon, as represented by either the blue or the yellow bands, increases gradually with the star's development. As Dunér's method of observation was better adapted than our own to show differences in the relative intensities of the bands, we would nevertheless attach greater weight to his opinion on this subject.

It will be noticed that the order of development in our series corresponds exactly with that given by Dunér in his memoir. In fact, so far as our results are comparable with those of Dunér, they generally tend to confirm them in all respects.

With few exceptions, spectroscopists have agreed that on account of the close resemblance between the two great classes of red stars, their spectra should be classed together. This was the view of Vogel when he prepared his system of classification and provided in the two subdivisions of his third class for the stars of Secchi's third and fourth types. Dunér, to whose valuable memoir we have had so many occasions to refer, considered that his observations went to confirm Vogel's classification, which he adopted without modification. Pechüle, on the contrary, held that the stars of Secchi's third and fourth types could not be considered as co-ordinate branches starting from the Sun, since no star was known to occupy a position intermediate between that of a fully developed fourth-type star and the Sun. As Pechüle's memoir is not accessible to us, we quote the following extract as given by Lockyer in *The Meteoritic Hypothesis* (p. 346):

M. Vogel a proposé une classification suivant les diverses phases de refroidissement indiquées par les spectres, dans laquelle il fait des types III et IV de Secchi deux subdivisions d'une même classe, IIIa et IIIb. Mais je trouve certaines difficultés négatives contre cette classification relativement au rôle qu'y joue le IIIb. En effet, il est admis que le IV type de Secchi se distingue nettement du III type, non seulement par la position et la quantité des zones obscures, mais aussi par le fait très-remarquable, que les principales de ces zones sont bien définies et brusquement interrompues du côté du violet dans le III type, du côté du rouge dans le IV. Or, si le IV type doit représenter une des phases de refroidissement, par lesquelles passent les étoiles, on peut faire deux hypothèses. La première est que le spectre du IV type soit co-ordonné au spectre du III type, de manière qu'il y ait des étoiles, qui passent de la phase représentée par le II type, à la phase représentée par le III type, et d'autres, qui passent directement du II type au IV. Mais cette hypothèse est inadmissible. Car on connaît des spectres intermédiaires entre le I et le II type, et entre le II et III; mais on ne connaît pas, à ce que je sache, des spectres du II type tendant au IV. Reste donc l'hypothèse, que la phase de refroidissement, représentée par le spectre du IV type, soit postérieure à la phase représentée par le III type, de manière que les spectres des étoiles passent du III au IV type. Si ce passage se fait peu à peu, il devrait y avoir des spectres intermédiaires entre le III et le IV type; mais quoique Secchi par example le 17 janvier 1868, ait déterminé le spectre de l'étoile 273 Schjell., comme semblant intermédiaire entre le III et le IV type, il l'a plus tard reconnu du IV type, et l'existence des spectres de III–IV type n'est nullement prouvée. On pourrait objecter que les étoiles du IV type sont peu nombreuses et en général si petites que leurs spectres sont difficiles à voir, et que par conséquent il pourrait y avoir parmi ces spectres quelquesuns, qui se rapprochassent du III type. Mais je réponds à cette remarque, que les spectres du III–IV type, indiquant une phase moins refroidie, devraient au contraire en général appartenir à des étoiles plus grandes que celles ayant des spectres du IV type. Si on veut supposer que le passage du III au IV type se fasse subitement, ou par une catastrophe, pendant laquelle apparaissent des lignes brillantes, cette supposition même constituerait une différence physique bien plus distincte entre le III et le IV type qu'entre le II et le III; et le IV type représenterait une phase bien distincte, la dernière peut-être avant l'extinction totale. Le rôle physique du IV type est donc encore si mystérieux, que j'ai cru pouvoir encore me conformer à l'exemple de d'Arrest, en suivant la classification formelle de Secchi.

Pechüle's objections were well answered by Dunér, who showed that in view of the comparatively small number of stars known to have spectra of Secchi's fourth type, it is not at all surprising that objects representing the transition from the solar stage have not been observed. As Dunér very justly remarks, it would be difficult to recognize stars in this transition stage without a much more thorough spectroscopic survey than has yet been made. Although 280 *Schjellerup*, which represents the earliest state of a fourth-type star that we have observed, contains many features characteristic of the fourth type, these might easily be overlooked in photographs taken with very low dispersion. As the spectra reproduced in Plates VIII and IX show, the carbon absorption bands in this star are relatively very feeble. In the yellow, the band is reduced to a single pair of heavy lines. Stars earlier in point of development would of course show even less marked evidence of carbon absorption, and would probably be classed as solar stars. 541 *Birmingham* (*DM.* $+38°3957$), the star considered by Dunér to represent better than any other the transition stage, is shown by our photographs to have a spectrum practically identical with that of 280 *Schjellerup* (though we have no evidence as to the presence of the bright $H\beta$ line). It may confidently be expected that when spectra of the solar type are better known, objects intermediate in development between 280 *Schjellerup* and the Sun will be discovered. This argument of Dunér's, which we can only confirm, disposes of Pechüle's principal objection to Vogel's classification. We shall have occasion farther on to refer more particularly to the close resemblance between the line spectra of the third and fourth types, as well as to other details which lead us to adopt the views of Vogel and Dunér.

According to the classification of stellar spectra developed by Lockyer in conjunction with his meteoritic hypothesis, stars of Secchi's third and fourth types are far removed from each other in point of development. The third type represents a swarm of meteorites in the first stage of transition from the nebulous to the stellar condition, while the fourth type represents the last stage in stellar life, immediately following the condition of the Sun.

So far as the fourth-type stars are concerned, .it therefore appears that Lockyer adopts the view held by other investigators, and confirmed by the present research, namely, that they represent the last stage of stellar development. But we do not think that he has given sufficient reasons for separating fourth-type stars from those of the third type. In the first place, we are unable to understand how the spectra of third-type stars can be considered to resemble in any way the spectra of nebulæ, or to be evolved from nebular spectra. So far as we are aware, no star showing a spectrum intermediate in character between that of a nebula and the spectrum of a third-type star has hitherto been detected. This seems to us a most serious objection to Lockyer's classification.

Furthermore, the results of the present investigation offer reasons for believing that the two great classes of red stars are closely related to each other, and that they are to be regarded as co-ordinate branches, each of which can be traced back to the Sun. The dark lines of the two types agree remarkably well (Plates X and XI). There is every reason to believe that if the bands were absent from the two types of spectra the line spectra would resemble each other very closely indeed—much more closely than either would resemble the spectrum of the Sun (Fig. 2, Plate XI). The chief distinction between the two types is thus confined to the bands and flutings, and even here we have a close resemblance in the case of cyanogen. The great strength of the λ 4227 calcium line, and the probable presence as conspicuous features in both types of the lines greatly widened in Sun-spots, certainly tend to emphasize the relationship of the two classes of red stars. It would seem very important to secure further evidence regarding the question of widened lines, especially with reference to their exact identification in third-type spectra. If Sun-spots exist on these stars, they can hardly be regarded as slightly condensed meteor swarms, as required by the meteoritic hypothesis.

We may sum up the points of resemblance of third- and fourth-type stars as follows:

The stars resemble each other: (1) in their red color; (2) their remarkable tendency to variability; (3) the very close resemblance of the dark lines in their spectra; (4) the possibility that

the spectra of both may contain the lines which are widened in Sun-spots; (5) the similar physical conditions indicated by the character of their spectra; (6) the presence of bright lines in their spectra; (7) the presence in their spectra of dark flutings, of which the cyanogen flutings are common to both types; (8) the connection between both types of spectra and the spectra of solar stars.

Some of these points of resemblance are suggested rather than demonstrated by the results of the present research, and much work must be done in the future on the spectra of both these classes of stars. But we believe that the existing evidence is decidedly favorable to the views of Vogel and Dunér, and that stars of Secchi's third and fourth types should therefore be classed as co-ordinate branches, having their origin in solar stars.

Apart from the evidence afforded by the similarity of stars of the third and fourth types, certain other considerations bearing on the general question of classification should be presented here. It has already been shown that the Wolf-Rayet and fourth-type stars have three points in common: (1) their tendency to cluster in the Milky Way; (2) the presence in their spectra of bright lines, a few of which may be common to both types; (3) the presence in their spectra of both bright and dark hydrogen lines. If any organic relationship between these two classes of stars could be established, it would conflict seriously with current ideas regarding stellar evolution. The Wolf-Rayet stars, for many excellent reasons, are generally believed to be related to the *Orion* stars, and to precede stars like *Sirius* in point of development. We consider that the results of the present investigation do not oppose this view, but rather tend to strengthen it. In the first place, we are not prepared to say that the tendency of certain classes of stars to cluster in or near the Milky Way necessarily indicates any organic relationship between such objects. If it were assumed, for example, that the fourth-type stars are at immense distances from the Earth,[64] and that an absorbing medium, most dense near the poles of the Milky Way, exists in space, an apparent clustering of these stars toward the Milky Way would result. It would be impossible, of course, to account in this way for the fact that *all* of the Wolf-Rayet stars occur in the Milky Way (or in the Magellanic Clouds), but it does seem to follow that such a distribution of the fourth-type stars as we actually observe need not indicate any relationship with Wolf-Rayet stars.[65] Bright lines have been found in so many different types of spectra that they cannot be regarded as a safe basis for classification, and they are not employed for this purpose. Finally, as we have already remarked (p. 131), the variations in the relative intensities of the hydrogen lines in nebulæ, Wolf-Rayet stars, third-type variables, and meteors are such as to permit no final conclusion to be drawn at present as to the physical condition implied by these phenomena. We therefore see no reason to believe that any important relationship connects the Wolf-Rayet and the fourth-type stars, though the bright lines and the physical condition of hydrogen in both should be made the subjects of further investigation.

The variations of the relative intensities of certain lines of titanium have an interesting bearing on the general classification of stellar spectra. The line λ 4534.14, ascribed by Rowland to *Ti-Co*, is first seen in β and γ *Orionis* as an extremely faint and diffuse darkening on the continuous spectrum. The line grows steadily stronger in the following stars: ζ *Tauri*, γ *Corvi* (Vogel's I*b*), ϵ *Ursae Majoris*, *a Cygni*, *a Canis Majoris* (Vogel's I*a*2)—and reaches maximum intensity in *a Persei*, where it is narrow and sharp, and in ϵ *Aurigae*, where it is broad. The line then decreases in intensity through the solar stars γ *Piscium* and *a Boötis*, and in the third-type stars *a Orionis* and *a Tauri*, where it is the faintest line of the titanium group. In the fourth-type stars this line is the only one of the titanium group which is absent. In the spark spectrum of titanium, the line varies greatly

[64] Professor Boss, who has very kindly looked up for us in his records the proper motions of a large number of fourth-type stars, finds that for seventeen stars the average proper motion is only about 0.″01, while in other cases, which are not so well determined, the proper motion is apparently in no instance greater than 0.″10, and for more than half the stars it is less than 0.″05.

[65] The assumption that stars may differ in chemical composition, and that this may be related in some way to their distribution in space, must not be left out of account in an exhaustive discussion of stellar classification; but it need not be considered here.

with change of self-induction in the secondary circuit, becoming fainter with increasing self-induction. It is stronger in the spark than in the arc.

The three lines of the group λ 4538.8 – 4536.3, on the other hand, are absent or very faint in all of the stars preceding γ *Piscium* in the above list. They then appear as strong lines, and they are strongly represented in solar, third-type, and fourth-type stars. The changes of these lines are illustrated in Fig. 3, Plate XI. All of the photographs, except that of the fourth-type star 132 *Schjellerup*, were made with the Bruce spectrograph by Messrs. Frost and Adams, to whom we are indebted for some of the information given here.

SUMMARY OF RESULTS AND CONCLUSIONS

1. The spectra of stars of Secchi's fourth type contain a large number of bright and dark lines, in addition to the violet flutings of cyanogen and the flutings of the Swan spectrum.

2. The approximate radial velocities of eight stars range from + 5 km. to – 28 km.

3. Measures of the wave-lengths of 307 dark lines (average probable error of the mean, 0.07 t.m.) indicate that the following substances are represented: carbon (as cyanogen and in the elementary or combined state corresponding to the Swan spectrum), hydrogen, vanadium, calcium, magnesium, sodium, iron, chromium, titanium, nickel, manganese, and possibly two or three other substances.

4. The carbon and metallic vapors are very dense, and lie immediately above the photosphere.

5. Above these dense vapors of the reversing layer rise other vapors or gases, represented in the spectra by bright lines. The conditions are thus similar to those that exist on the Sun.

6. The bright lines, of which about 200 are present, seem to represent unknown gases, since none of them could be identified with certainty. A few of these lines may perhaps correspond with bright lines in the spectra of Wolf-Rayet stars.

7. The great strength of such lines as λ 4227 of calcium, and the fact that arc and flame lines are strong, while spark lines are less prominent or missing, suggests, though it does not prove, that the temperature of the reversing layer may be lower than in the case of the Sun.

8. The fact that many lines widened in Sun-spots are represented by strong dark lines suggests that spots similar to those on the Sun may be numerous on fourth-type stars.

9. In the spectrum of 19 *Piscium* $H\gamma$ and $H\delta$ are present as dark lines, while $H\beta$ is absent. In the spectrum of 280 *Schjellerup* and in some of the other stars $H\beta$ appears as a bright line. Fourth-type spectra thus resemble spectra of the Wolf-Rayet type in showing the more refrangible hydrogen lines dark and the less refrangible ones bright or absent.

10. The bright $H\beta$ line in the spectrum of 280 *Schjellerup* undergoes variations of intensity.

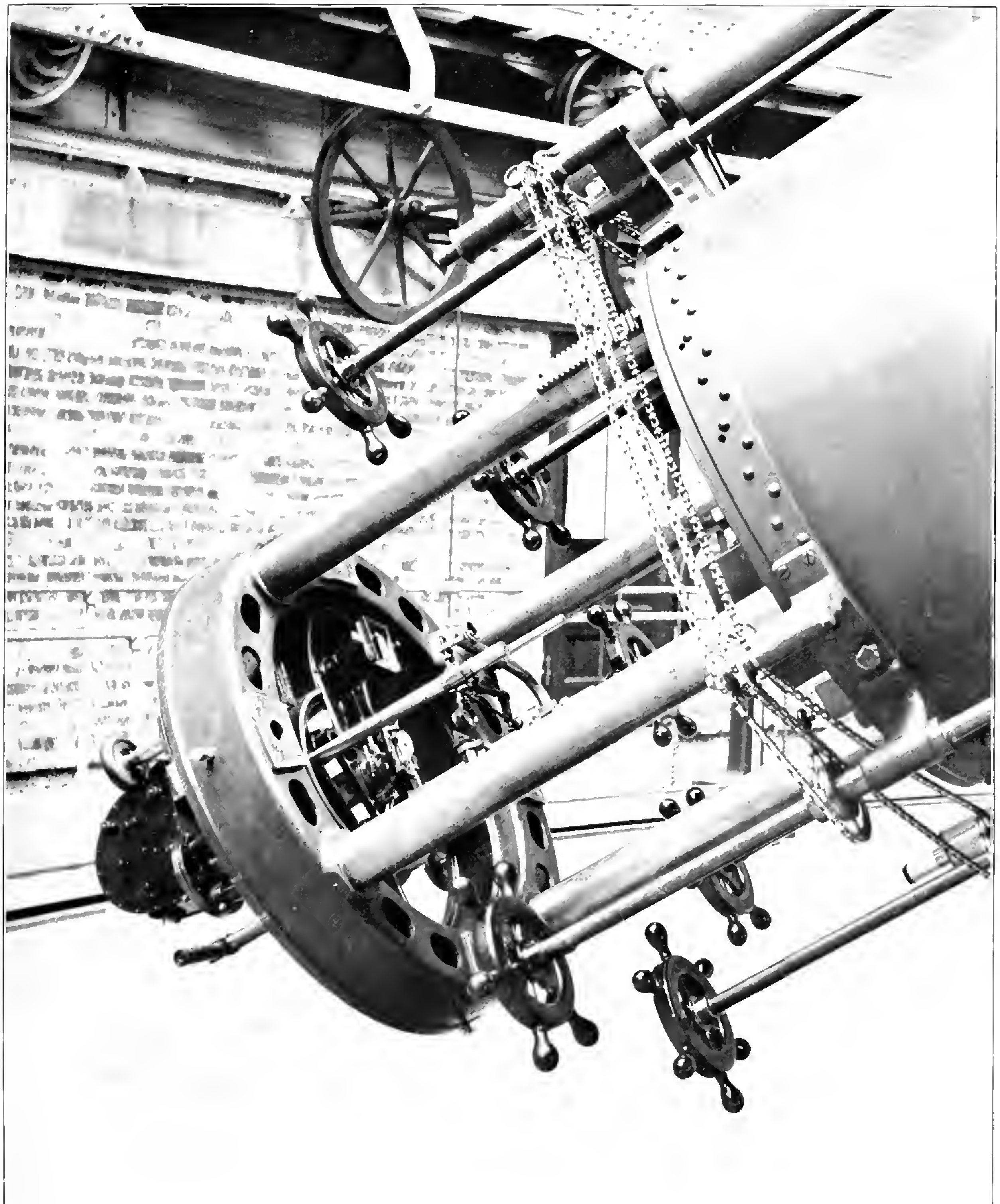
11. About 20 per cent. of the fourth-type stars are variable. The tendency to variability, therefore, seems to be even greater than in the case of stars of Secchi's third type.

12. The condensation of fourth-type stars in and near the Milky Way is very marked.

13. Stars of the third and fourth types resemble each other in color, tendency to variability, spectra, possible presence of Sun-spots, physical condition, and probable relationship to solar stars. They should therefore be classed together, as co-ordinate branches leading back to stars like the Sun.

14. Variations in the relative intensities of certain titanium lines indicate that fourth-type stars are probably very widely separated from Wolf-Rayet stars in point of development.

15. Fourth-type stars probably develop from stars like the Sun through loss of heat by radiation.



THREE-PRISM SPECTROGRAPH ATTACHED TO FORTY-INCH REFRACTOR

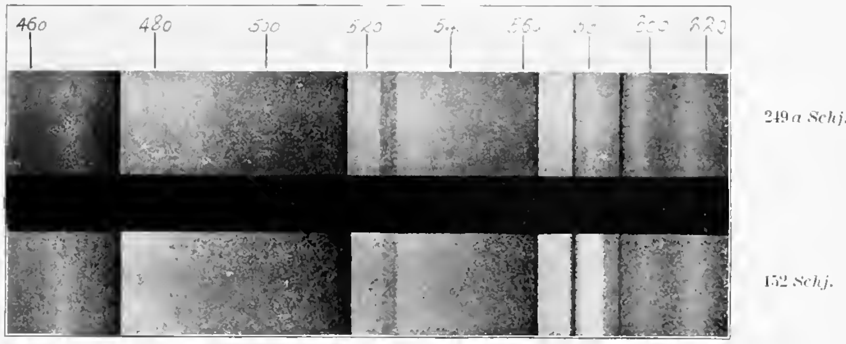


FIG. 1. SPECTRA OF FOURTH-TYPE STARS (VOGEL)

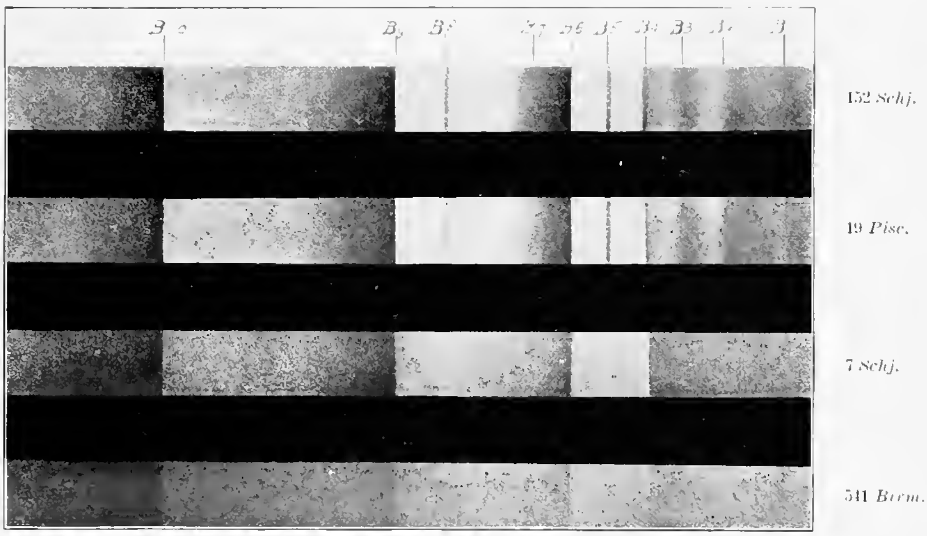


FIG. 2. SPECTRA OF FOURTH-TYPE STARS (DUNÉR)

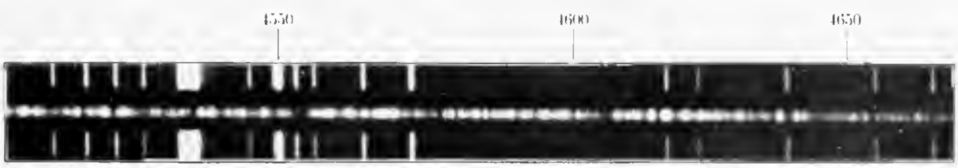


FIG. 3. BRIGHT LINES IN THE SPECTRUM OF 132 *SCHJELLERUP*

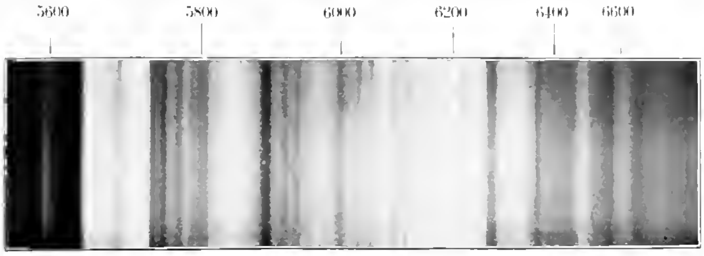


Fig. 1. Red End of the Spectrum of 152 *Schjellerup*

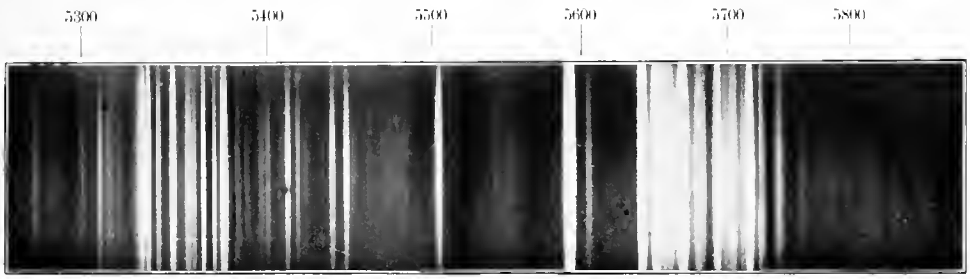


Fig. 2. Bright Lines in the Spectrum of 152 *Schjellerup*

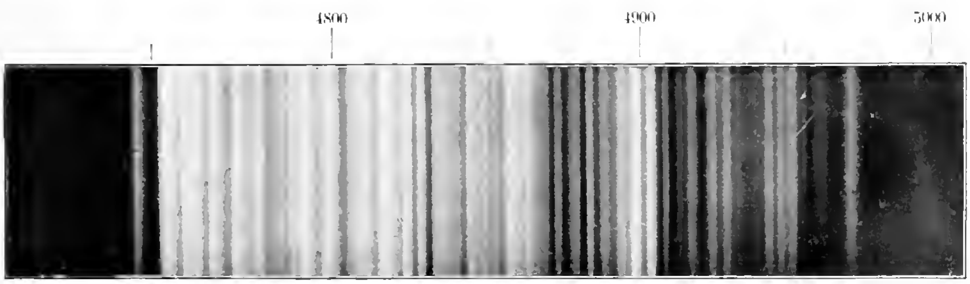


Fig. 3. Bright Lines in the Spectrum of 152 *Schjellerup*

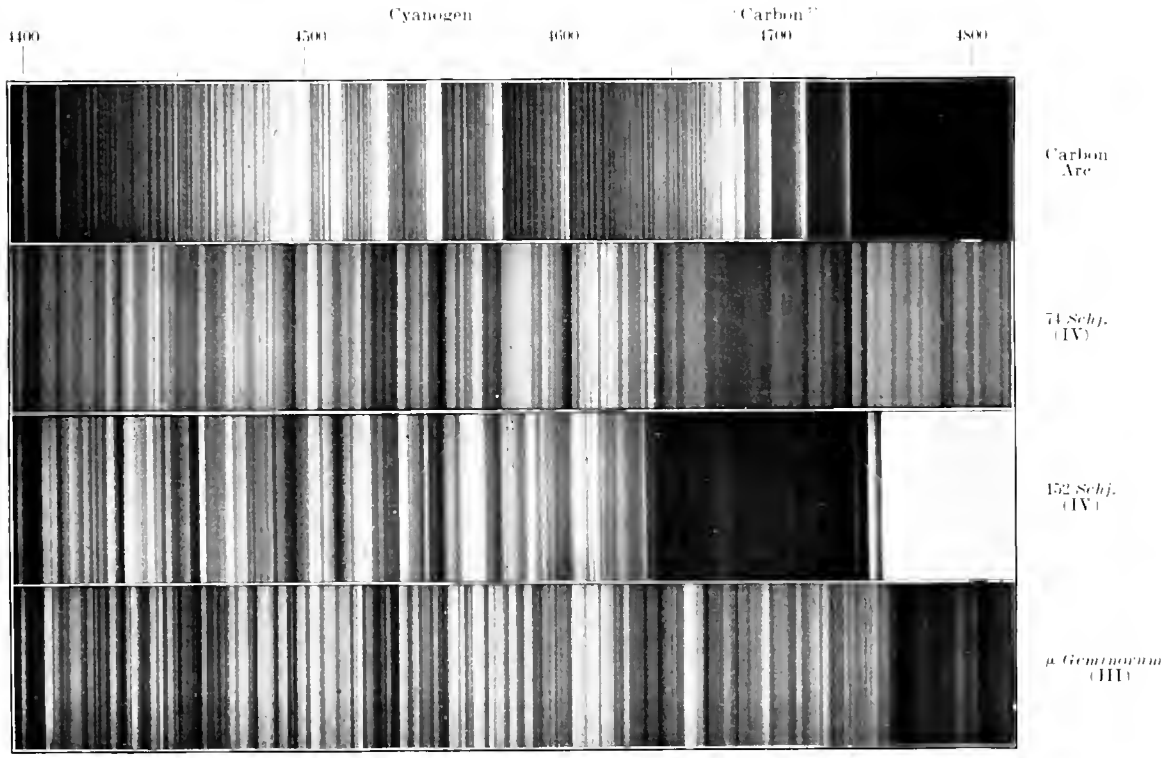


FIG. 1. BLUE CYANOGEN AND "CARBON" FLUTINGS

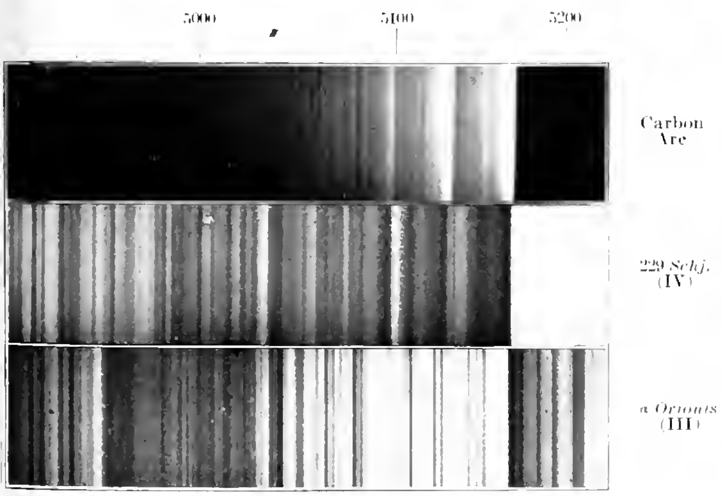


FIG. 2. GREEN "CARBON" FLUTING

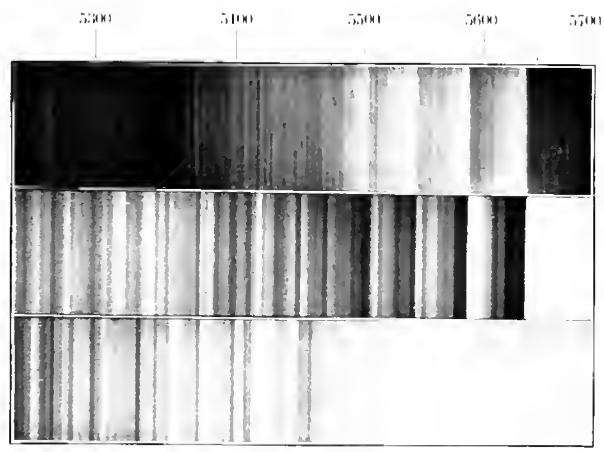
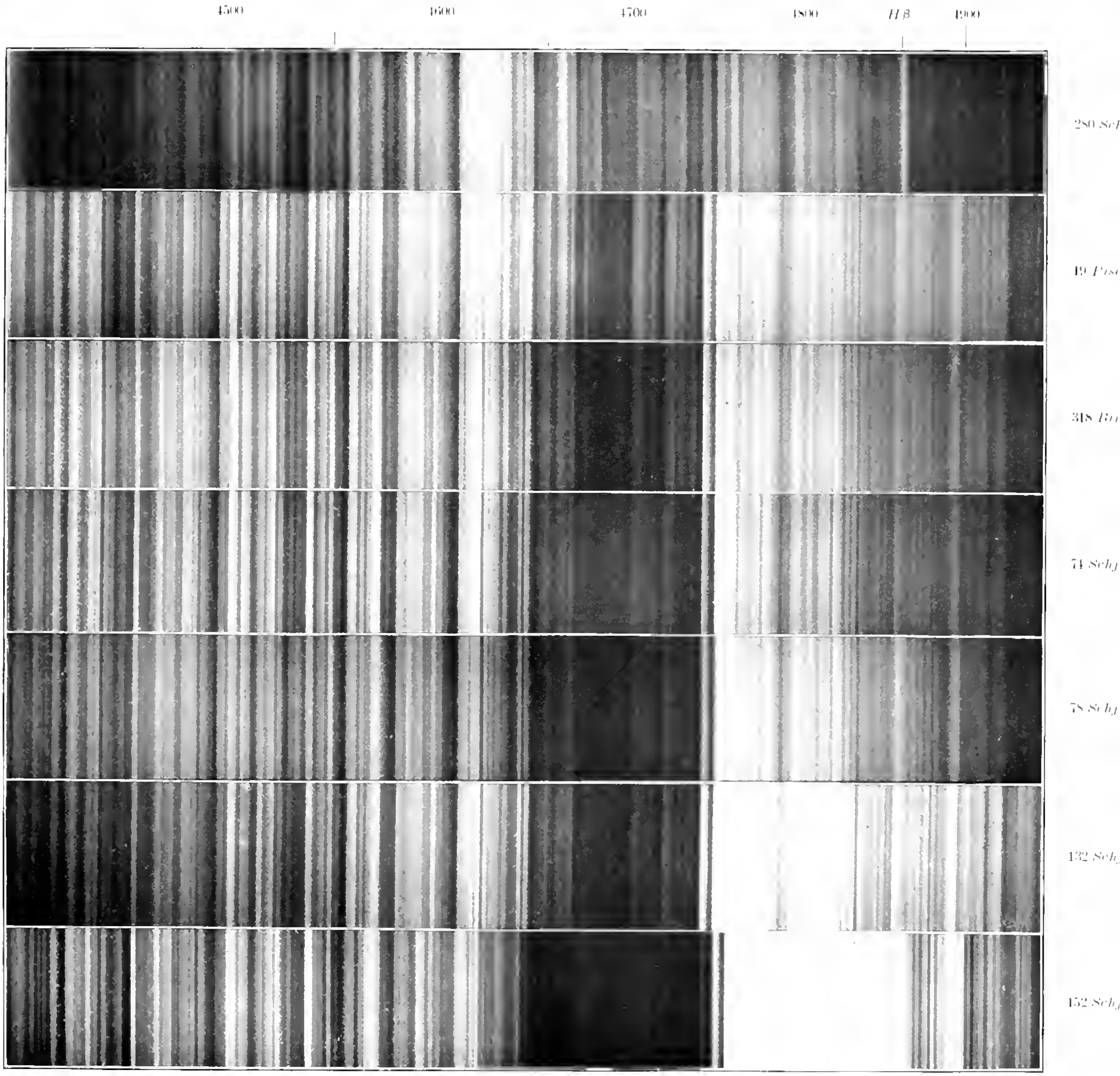
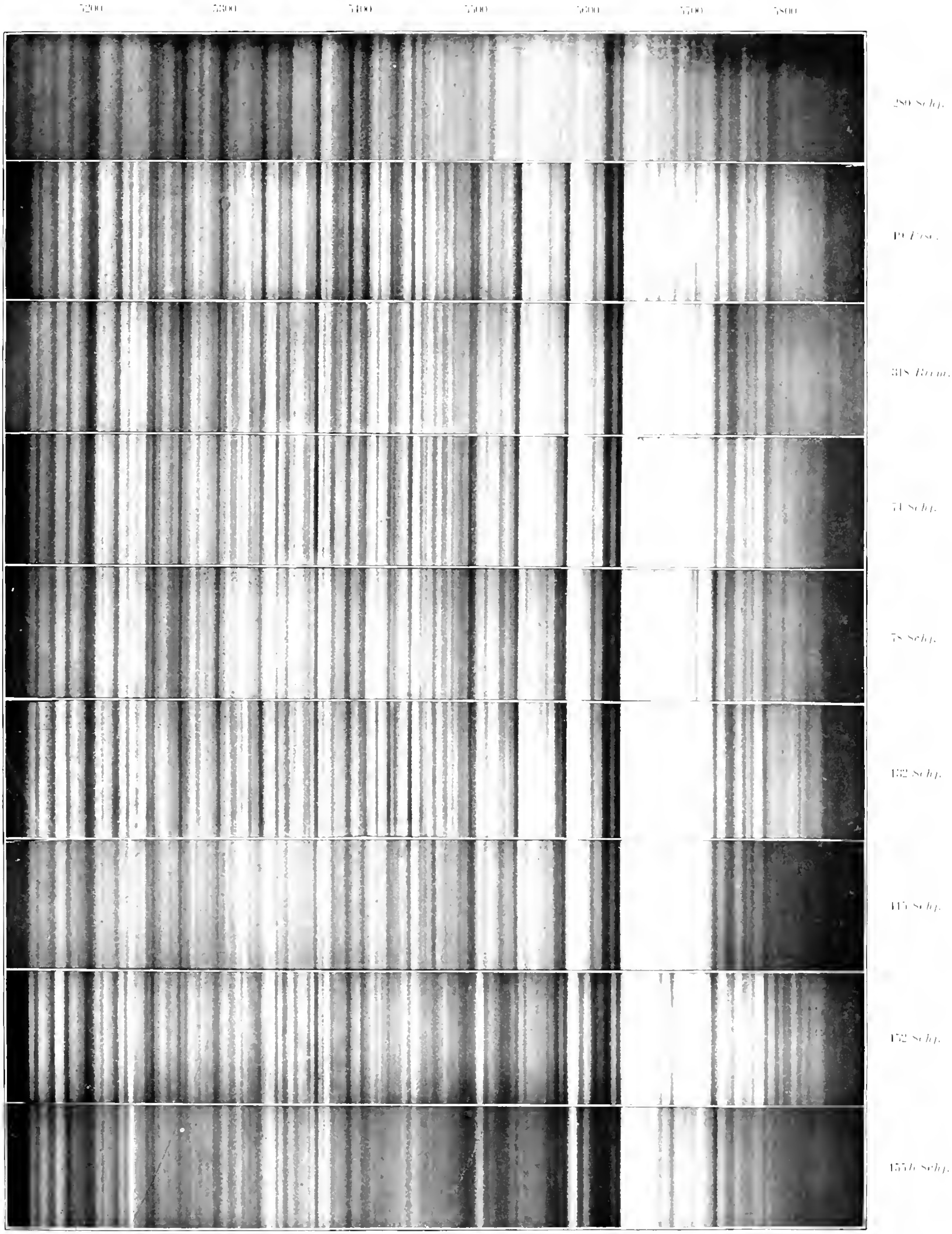


FIG. 3. YELLOW "CARBON" FLUTING

SPECTRUM OF CARBON ARC COMPARED WITH SPECTRA OF THIRD AND FOURTH TYPES



SPECTRA OF FOURTH-TYPE STARS (BLUE REGION)



SPECTRA OF FOURTH-TYPE STARS (YELLOW AND GREEN REGION)

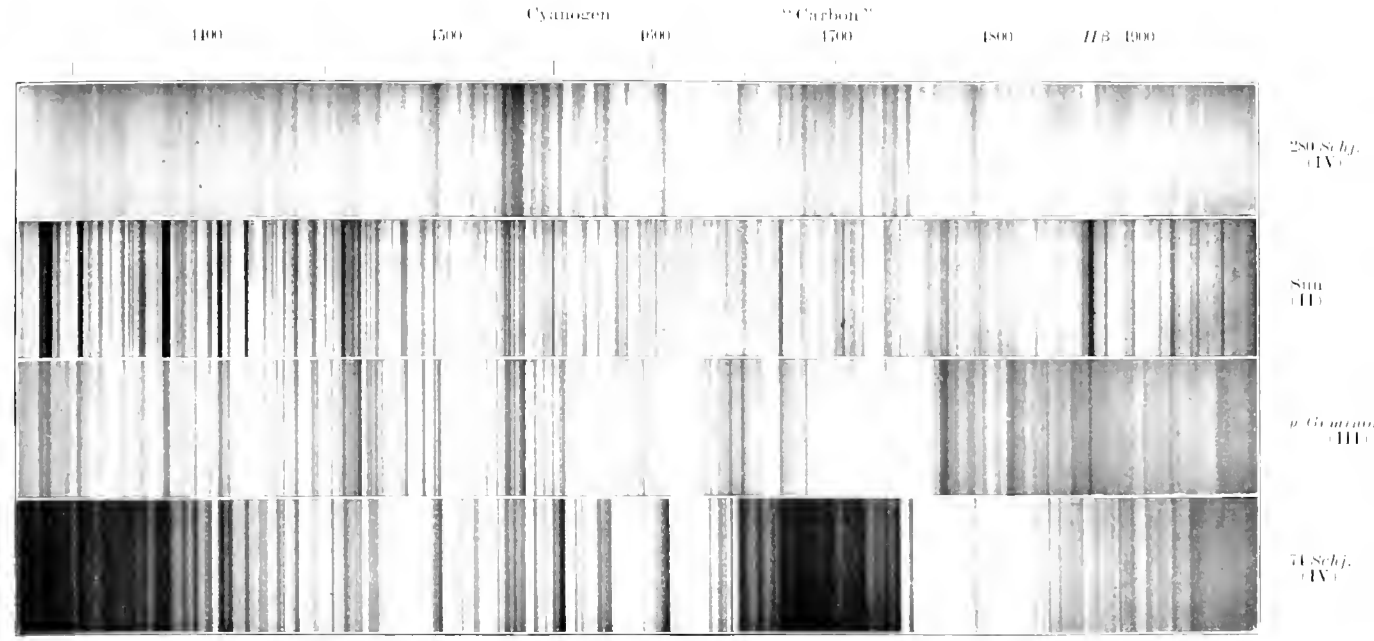


Fig. 1. Blue Region

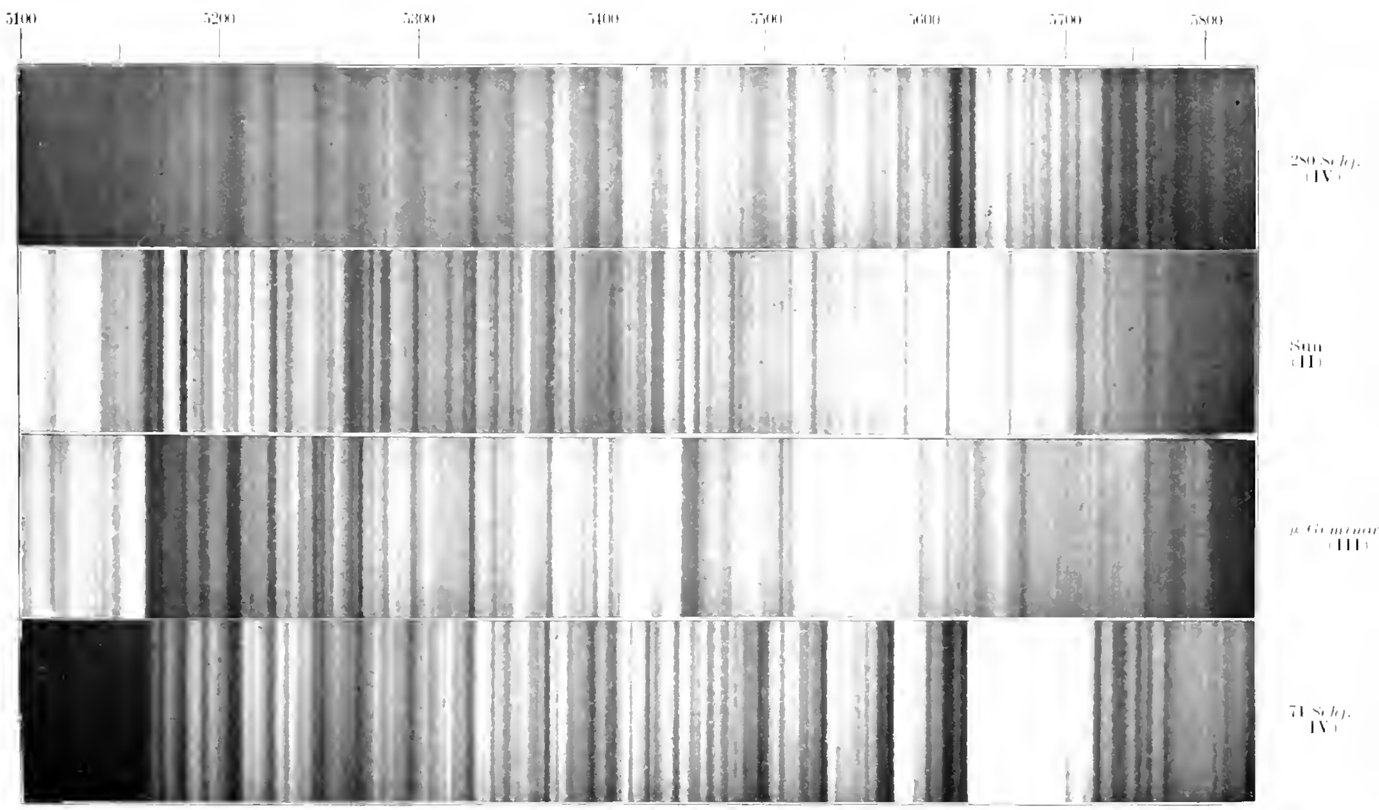


Fig. 2. Green and Yellow Region

COMPARISON OF SPECTRA OF SECOND, THIRD, AND FOURTH TYPES

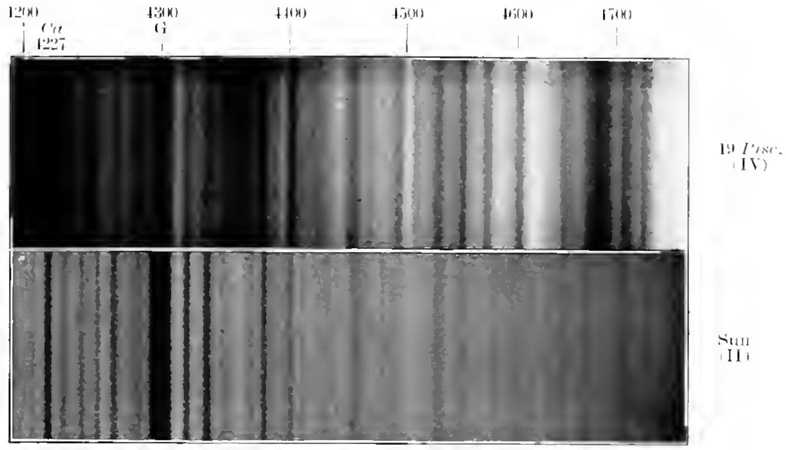


FIG. 1. SPECTRA OF SECOND AND FOURTH TYPES (BLUE REGION)

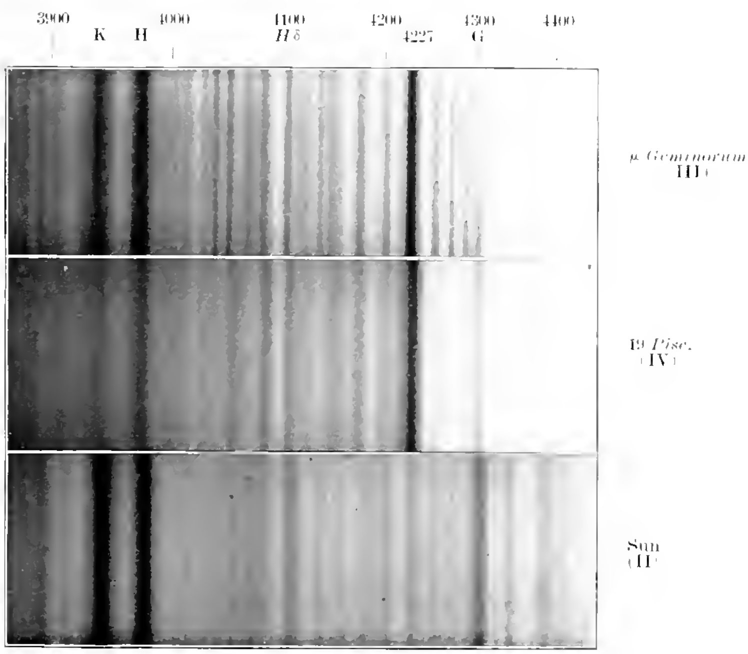


FIG. 2. SPECTRA OF SECOND, THIRD, AND FOURTH TYPES (VIOLET REGION)

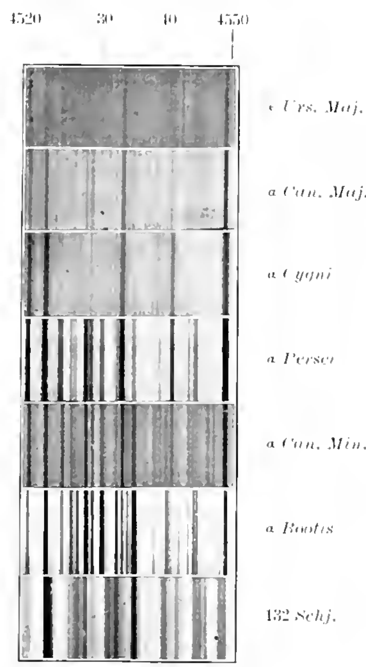


FIG. 3. TITANIUM LINES IN STELLAR SPECTRA

PHOTOGRAPHY WITH FORTY-INCH REFRACTOR AND TWO-FOOT REFLECTOR

ASTRONOMICAL PHOTOGRAPHY WITH THE FORTY-INCH REFRACTOR AND THE TWO-FOOT REFLECTOR OF THE YERKES OBSERVATORY

G. W. Ritchey

I. PHOTOGRAPHY WITH THE FORTY-INCH REFRACTOR

In the original design of the forty-inch refractor of the Yerkes Observatory no provision of any kind was made for direct photography. The objective is a visual one; there is no photographic corrector such as was provided for the great Lick refractor; and there is no powerful auxiliary telescope for guiding, such as are used in the cases of the "standard" photographic telescopes and of the very large photographic refractors at Potsdam and Meudon.

By the use of a method perfected by the writer in 1900, and described in the *Astrophysical Journal* for December of that year, the forty-inch visual refractor was made available for direct photography. The photographic attachment is simple and inexpensive; the entire apparatus cost less than $100. A large number of photographs of star-clusters and of the Moon have been obtained, which are valuable on account of their great scale and fine definition.

The results described in the above-mentioned article were obtained with a small photographic attachment which allowed a field only three inches (about fourteen minutes of arc) square to be photographed at one time. A similar, but larger and more perfect, attachment, taking 8×10-inch plates, has since been constructed from my designs, for use with the great refractor. This allows a field of approximately 36×45 minutes of arc to be photographed at one time, and of course includes the entire disk of the Moon. Many of the photographs described in the present article have been made with the larger apparatus.

The photographic attachment consists of a double-slide plate-carrier for guiding, on which is supported the plate-holder containing a yellow color-screen or ray-filter very nearly in contact with a yellow-sensitive (Cramer instantaneous isochromatic) plate.

The yellow screen freely transmits to the sensitive plate the sharp and intense yellow or visual image produced by the visual objective, and effectually excludes from the plate the blue and other wave-lengths of light which are not included in the visual image, and which would entirely destroy the sharpness of the photographs. Two very fine 8×10-inch yellow screens, one of slightly stronger tint than the other, were obtained after some experimenting. Each screen consists of two thin plates of glass, ground and polished approximately flat; one of these is coated with a film of collodion of a delicate yellow tint. After the collodion film is dry it is flowed with Canada balsam, and the second thin plate, which serves as a cover-glass, is put on. The two plates are bound together with adhesive tape. The screens are brilliantly transparent. When in use one of the screens is placed in the plate-holder directly in front of the yellow-sensitive plate. Screen and plate are separated only by the thickness of the binding tape around the edges of the former.

The double-slide plate-carrier, a device originally suggested by Dr. Common and described by him in *Monthly Notices*, Vol. XLIX, p. 297, permits very perfect guiding or following to be done, without the necessity of an auxiliary or guiding telescope. The large photographic attachment of the forty-inch refractor is illustrated in Plate XII. When in use, the apparatus is connected by four bolts to the large and massive ring, well shown in the illustration, to which all of the various attachments, spectroscopes, etc., with the exception of the micrometer, are in turn connected. This large ring can be racked in and out, and firmly clamped in any position, thus serving for focusing the various attachments. When the four connecting bolts are loosened, the entire attachment can be rotated in position-angle. Such rotation of the double-slide plate-carrier alone can be accomplished by means of the two

smaller rings (one of which can be rotated on the other) which directly support the double-slide. This rotation is convenient, and often necessary, in finding a suitable guiding star. The double-slide arrangement, one slide being at right angles to the other, is shown fairly well in the illustration. The two screws with large milled heads, by which the slides are moved in guiding, are well shown, one to the right of, the other below, the rectangular frame or box which carries the 8×10-inch plate-holder. The plate-holder is not shown.

To the upper side of the rectangular box is connected the small eyepiece by means of which the guiding star at the edge of the field being photographed is watched. A small diagonal prism, which can be seen inside of the rectangular box, overhangs the edge of the photographic plate, receives the light of the guiding star, and reflects it at right angles into the eyepiece. By this arrangement it is almost always possible to use a guiding star whose image is less than four inches distant from the center of the field being photographed. In the eyepiece are two fine cross-lines of spider-web, which are illuminated by faint red light from a very small incandescent lamp, the tubular socket for which is attached to the side of the eyepiece tube. To assist in finding a suitable guiding star, the eyepiece and its accessories are mounted on a slide which can be moved to any desired position on the upper side of the rectangular box, and firmly clamped there. The star which is to be used in guiding is brought to the intersection of the cross-lines in the eyepiece, and is kept there throughout the exposure of the sensitive plate, sometimes lasting four or five hours. The observer sits with his eye at the guiding eyepiece and his fingers on the two screws which move the slides, and thus he introduces any minute corrections of position which he sees are necessary.

The guiding eyepiece gives a magnifying power of about one thousand diameters. It is very seldom, indeed, that a star-image appears quiet in a very large telescope with such a magnifying power as this. Minute irregularities in the movement of the telescope in right ascension are almost always present, and render necessary continual watching and guiding. But larger and more troublesome are the irregular movements of the image which are due to the disturbed condition of the atmosphere. The effects of this lack of tranquillity and homogeneity of the atmosphere are of many kinds. Sometimes the image of the guiding star appears nearly quiet, but is very large and nebulous. At other times the star-image is a small brilliant point, but is dancing about so rapidly that many hundreds of corrections per minute would be necessary in order to follow it. After months of practice with the guiding apparatus the observer is able to introduce between one hundred and two hundred corrections per minute, when necessary. The work becomes almost automatic, but is extremely trying to the eyes when the tremors of the guiding star are rapid. The corrections can be made with great accuracy and almost instantaneously with the double-slide plate-carrier — with an effectiveness incomparably superior to that which can be attained by any other means now known.

The question arises whether the irregular movements of the images of the objects being photographed correspond exactly with those of the image of the guiding star. It would not be difficult to devise an apparatus by means of which the images of two or more stars in different parts of the field could be brought into apparent superposition, and thus this question could be answered. This has not been done, but the sharpness of the photographs obtained when guiding is done with great care is so superior to that resulting from less careful guiding that the conclusion is warranted that when the image of the guiding star is kept at the intersection of the cross-wires, the images of the objects being photographed are kept immovable on the photographic plate.

I have described the double-slide plate-carrier and its use somewhat in detail, because of the very great importance of this apparatus in long-exposure photography, especially with large telescopes. It has been asserted by prominent astronomers that such difficult objects as the dense star-clusters and the planets could never be satisfactorily photographed, because the very powerful telescopes which are necessary to show these objects satisfactorily are so large and heavy that they cannot be moved with the delicacy and quickness necessary to compensate for the constant irregular tremors always visible

with such great telescopes. Experience with the forty-inch refractor, with its enormous weight, the largest instrument thus far successfully used in direct photography, shows that the difficulty is completely solved by the use of the double-slide plate-carrier, in which the mass to be moved in making the necessary corrections is two or three pounds instead of ten or twenty tons. It is safe to assert that for the largest telescopes which could now be constructed, refractors or reflectors, the problem of efficient guiding during long exposures in direct photography is satisfactorily solved.

The photographs of star-clusters and the Moon obtained with the forty-inch refractor and its photographic attachment are certainly not inferior in separation or resolution to those obtained with the largest and best telescopes constructed especially for photography. In the best photographs of star-clusters obtained with the former instrument double stars of 1″ distance are distinctly separated and measurable; and in the best lunar photographs craters one second of arc in diameter (corresponding to a little more than one mile) are shown as distinct rings. These results are due in part to the great size and focal length of the telescope, and in part to the effectiveness of the yellow screen in transmitting to the sensitive plate only those wave-lengths of light for which the color-curve of the objective is very nearly flat.

Even more surprising is the speed of the color-screen method. Although the ratio of focal length to aperture of the telescope is nearly as 19 to 1, fully timed photographs of the Moon are obtained with exposures varying from one-fourth of a second to one second. Stars which are at the visual limit of the instrument (approximately seventeenth magnitude) are photographed with two hours' exposure when atmospheric conditions are good, and with the most rapid yellow-sensitive plates. With five hours' exposure stars fully a magnitude fainter are photographed. This speed is possible, however, only after the observer has become expert in the use of the guiding apparatus, so that he introduces the necessary corrections instantly and almost automatically.

While this speed is greatly inferior to that of a well-made modern reflecting telescope with silvered glass mirrors, it is probable that the forty-inch visual refractor with the color-screen and the best yellow-sensitive plates now obtainable is nearly, if not quite, as rapid in photographing stars and the Moon as a forty-inch photographic refractor (one with its objective corrected for the blue, or so-called photographic, rays) would be. This opinion is based, in part, upon a comparison of photographs obtained with the largest photographic refractors and those obtained with the forty-inch visual instrument. The yellow-screen method utilizes the rays of light which are most freely transmitted by a large objective; it is a well-known fact that while only a small percentage of the yellow rays are lost by transmission through a large and necessarily thick objective, a very large percentage of the blue rays are thus lost; this is undoubtedly the reason why a yellow screen of delicate tint is sufficient to exclude the blue light from the photographic plate when this process is used with the forty-inch refractor.

The color-screen method and the double-slide plate-carrier are of course applicable for photography with all visual refractors, large or small, which are provided with clock-work for driving. By their use fainter stars can readily be photographed with any visual refractor than can be seen directly with the same instrument. In the work with the forty-inch refractor this is particularly noticeable in such cases as those of the fainter stars in the globular star-clusters. Stars which can be detected visually only with difficulty, and with fine atmospheric conditions, appear strong and distinct on the negatives obtained with moderately good atmospheric conditions.

In photographing the Moon at the focus of the forty-inch refractor (without amplification or enlargement of the image) the exposures required are so short that the double-slide plate-carrier is dispensed with, and a simpler apparatus is used to support the plate-holder. This apparatus is so arranged that an exposing shutter mounted in suitable guides can be moved across by hand, in front of the sensitive plate, in making the exposures. Diaphragms with apertures of various shapes, depending upon the phase of the Moon, are attached to the exposing shutter, and serve to equalize

the exposure time, the lunar terminator requiring a much longer exposure than that required for the bright limb. In making the photographs of the Moon, the instant of exposure is not chosen at random. An eye-piece with fine cross-wires is arranged in a tube with a diagonal prism at one end. This tube rests in a V-bearing, so that it can be instantly withdrawn without danger of jarring the telescope. The observer watches the lunar image by means of this eyepiece until an instant occurs when the definition is good and the image appears quiet with reference to the cross-wires; he then instantly withdraws the eyepiece tube (since this would overhang the photographic plate) and at the same time gives the signal to the assistant to move the exposing shutter across. I am indebted to Mr. F. L. Sullivan for able assistance in this and all other direct photographic work with the great refractor.

Plates XIII to XXI, which accompany this article, are from negatives obtained with the forty-inch refractor and its photographic attachment. The photograph of the lunar crater *Theophilus* and its surroundings (Plate XIII) is one of the best of the series, for it was made when atmospheric conditions were exceptionally fine, on the night of October 12, 1900. Much smaller details of the Moon's surface are shown here than have been photographed before. The exposure required in this case was less than one-half of a second. *Theophilus*, with its diameter of sixty-four miles, with its terraced wall or rampart rising three miles in vertical height above the crater-floor, with its great group of central mountains, and the enormous ridges and ravines of its outer slopes, is in many respects the most magnificent example of a lunar crater. The intricate system of radiating ridges of its outer slopes can be traced in the photograph for nearly one hundred miles from the crest of the rampart. Innumerable details are here reproduced with a minuteness and fidelity which are possible only by means of photography.

The illustration of *Mare Serenitatis* and *Mare Tranquilitatis* (Plate XIV) was obtained on the night of August 3, 1901, with an exposure of one second. The enlargement in this case is not nearly great enough to show the finer details visible in the negative, but was decided upon in order to include both plains on one plate. The surfaces of these plains are crossed by numerous ridges or wrinkles, large and small, which are beautifully shown in the original negatives, and on glass positives made from them, but which are difficult to reproduce, on account of the lack of sufficient contrast. The great serpentine ridge in *Mare Serenitatis* and the remarkable system of radiating ridges on *Mare Tranquilitatis* are among the most interesting features of the Moon's surface.

It was a fortunate coincidence, in the case of *Theophilus*, that exceptionally fine atmospheric conditions occurred when the crater was in the best position with reference to the terminator. No opportunity has occurred for photographing *Copernicus* under extremely fine conditions, although on account of the prominence of this superb object such an opportunity has been carefully watched for. The photograph of *Copernicus* shown in Plate XV is from a negative obtained on the night of November 20, 1901, with fairly good atmospheric conditions, and with an exposure of one-half of a second. While *Copernicus* is neither so large nor so deep as *Theophilus*, the system of radiating ridges and deep gullies constituting the outer slopes of the former is probably the most rugged and magnificent to be found on the Moon. The well-known rows of small craters at the west of *Copernicus*, as well as the much smaller rows to the south and northeast of the crater, are well shown in the photograph.

The illustration of *Mare Nubium* and *Bullialdus* (Plate XVI) is from the same large negative as that of *Copernicus*. The photograph shows well the remarkable details of the surface of this great plain—details strikingly different in character from those of *Mare Serenitatis* and *Mare Tranquilitatis*. The region of *Bullialdus* is in such a condition of illumination that it is particularly well seen. In the original negative the details of the outer slopes of *Bullialdus* are shown with remarkable sharpness; some idea of this can be gained from the half-tone illustration.

The photograph of *Clavius* and the surrounding region (Plate XVII) is also from the same negative as that of *Copernicus*. At the time when this photograph was taken the conditions of libration

and of illumination were unusually favorable for this region of the Moon's surface. *Clavius*, with its numerous included craters and other details; *Longomontanus* and *Wilhelm*, in which the details of the ramparts and of the crater-floors are unusually well shown; the extremely rough country north of *Wilhelm;* and the "metropolitan" crater *Tycho* conspicuous for its enormous depth, are among the most remarkable objects of this region.

The photograph of the great system of bright rays about *Tycho* (Plate XVIII) is from a negative obtained March 31, 1901. While the negative is not so extremely sharp as some others, a much greater enlargement than was possible here would be necessary to show well the astonishing richness of detail in this system of bright rays which is present in the original negative. The exposure time in this case was one-fourth of a second.

The half-tone process of reproduction is especially disappointing in the case of the star-clusters. Not only are hundreds of the fainter stars entirely lost, but the groups of bright stars which are sharply separated in the original negatives appear only as white patches in the half-tone illustrations. The writer expects to include, with the copies of this paper which are sent to observatories and individuals especially interested in astronomical photography, large prints, on photographic paper, of the subjects which have suffered most in reproduction by the half-tone process. The expense of these photographic prints has been met by a generous friend who is interested in the work.

The illustration of the Great Cluster in *Hercules, Messier* 13 (Plate XIX), is from a negative obtained on the night of April 25, 1901, with the large photographic attachment and with an exposure of three hours. In the original negative the center of the cluster is well resolved. Lines and groups of stars of between the sixteenth and seventeenth magnitudes, and with distances down to 1″, are well shown and distinctly separated. More than three thousand stars are shown on the negative, many of which are so faint that they are beyond the visual limit of the great telescope.

Smaller, but richer and more condensed, than *Messier* 13 is that superb cluster *Messier* 15 *Pegasi* (Plate XX), although the effect of richness and condensation is to a large extent lost in the illustration, on account of the great scale and the loss of the fainter stars. The sharpest negative of this object was obtained on the night of October 3, 1900, with an exposure of three hours. On account of exceptionally fine atmospheric conditions during nearly one hour of this exposure, this is one of the best of the star-cluster photographs. A comparison of this photograph with others of the same object which have been published will demonstrate the advantages of telescopes of great focal length, and of an efficient guiding mechanism, in the photography of these difficult objects.

Two or more very sharp negatives of each of the dense globular clusters *Messier* 2 *Aquarii, Messier* 3 *Canum Venaticorum*, and *Messier* 5 *Librae*, as well as of some of the larger and more open clusters, have also been obtained. It is believed that on account of the great scale and excellent definition of these photographs they will prove extremely valuable for comparison with photographs obtained several years later, in the search for change and rotation in these clusters.

The photograph of the central parts of the great nebula in *Orion* (Plate XXI) was obtained with the forty-inch refractor with an exposure of three hours, January 20, 1901. The night was extremely transparent, but atmospheric conditions were not fine in other respects, so that the star-images appear large. The yellow-screen process is not well adapted for the photography of nebulæ, since the light of these objects consists almost exclusively of green and blue rays. The blue rays are entirely excluded by the yellow screen, and the green rays, which are imperfectly transmitted (and by which the nebula is photographed) are not brought to a focus in the same plane in which the star-images are in best focus. But similar difficulties in regard to focus are encountered even with the best photographic refractors.

It is only with the reflecting telescope that the intolerable difficulties due to imperfect achromatism are entirely absent. In the present case the focal setting used was that which is best for the stars; consequently the details of the nebula are slightly out of focus. The photograph is introduced

in order to call attention to the difficulties just described, and also because, on account of the great scale, the details of the central parts of this celebrated nebula are shown better than in any other photographs of this object with which the writer is acquainted.

II. PHOTOGRAPHY WITH THE TWO-FOOT REFLECTOR

The two-foot reflector of this observatory (Plate XXII) was described somewhat at length in my article in the *Astrophysical Journal* for November, 1901; a detailed description of the instrument is therefore not necessary here; the following statements may, however, be made in regard to it:

The large mirror has a clear aperture of 23½ inches and a focal length of 93 inches. The instrument is used as a Newtonian for direct photography, and also as a Cassegrain for direct photography and spectroscopic work; the convex Cassegrain mirror is 5 inches in diameter and gives an equivalent focal length of 38 feet; as there is no central hole through the large mirror, three reflections are necessary when the convex mirror is used. The mounting is massive and rigid. The tube consists of a skeleton framework of steel tubes and cast-aluminum rings. The driving-clock and clock-connections are unusually large and strong. A small double-slide plate-carrier which allows a field three inches square to be photographed, is used for guiding in direct photography at either the primary or secondary focus. All of the mechanical parts of the instrument were made in the instrument shop of the observatory; the optical parts were made by the writer.

Special attention was given to the perfection of the optical parts; to the stability of the mirror supports and the rigidity of the skeleton tube, in order that the adjustment or collimation of the optical parts might remain perfect during long exposures; and to the refinement of the driving mechanism and the guiding apparatus. In nearly all respects the same degree of care and refinement was used in the making of this instrument as is given in the case of the best modern refractors.

The performance of the instrument in direct photography at the primary focus is highly satisfactory. As stated in my previous article, "the combination of (1) stability of position of the mirrors, (2) rigidity of skeleton tube, (3) smoothness of clock-driving, and (4) accuracy of guiding made possible by the use of the double-slide plate-carrier, is so effective that when atmospheric conditions are good the image of a guiding star in the eyepiece does not wander so much as one one-hundreth of a millimeter during an exposure of three or four hours. The accuracy with which the star-images are kept immovable on the photographic plate is nearly as great, as is shown by the photographs. In the best negative with four hours' exposure the images of the smaller stars near the center of the field are about 2″ in diameter. Double stars of 2″.5 distance are sharply separated, and those of 2″ distance, corresponding to about 0.02 mm. on the photographic plate, are measurable."

"No greater mistake could be made than to suppose that the finest atmospheric conditions are unnecessary to secure the best results in photographing the nebulæ. With such conditions the photographs show that these objects are not diffused hazy masses, but that their structure is generally most complicated, often consisting of exquisitely fine filaments and delicate narrow rifts. In these photographs the intersections of such filaments and rifts can be set upon, in the measuring machine, with almost the same degree of accuracy that is possible in the case of star-images. Changes of form in the nebulæ, if such occur, could be detected with certainty by means of such photographs."

A large refracting telescope, whether visual or photographic, is not an efficient and economical instrument for photography, either direct or with the spectroscope, when compared with a modern reflector. The two-foot reflector, with its focal length of ninety-three inches and with its aperture reduced to fifteen inches, photographs seventeenth-magnitude stars with two hours' exposure. This speed is equal to that of the forty-inch refractor with the color-screen, with the finest atmospheric conditions, *i. e.*, when the guiding star appears in the eyepiece as an extremely small point, and when irregular movements of the guiding star are so slow and so small that they can be readily followed. It is probable that this speed is nearly, if not quite, equal to that of the largest photographic refrac-

tors in use. When the full aperture is used, the two-foot reflector photographs seventeenth-magnitude stars with forty minutes' exposure.

That the great difference in speed between refractors and reflectors in photographing stars is not due largely to difference of angular aperture is amply proved by the few results which have been obtained with the two-foot reflector when used as a Cassegrain, *i. e.*, with the addition of the convex mirror, which gives an equivalent focal length of thirty-eight feet. Photographs made for comparison *when atmospheric conditions are good* (so that star-images appear as very small points even at the secondary focus), show that with this great equivalent focal length stars are photographed very nearly as rapidly as at the primary focus; the difference in speed is so slight that it is readily accounted for by the assumption that about 10 per cent. of the light is lost by the additional reflection at the convex mirror. I am aware that this result is apparently at variance with theories in regard to the effect of focal length (when the aperture remains constant) upon the size and intensity of the diffraction disks of star-images, and consequently upon the speed with which such images are photographed.

The great superiority of the reflecting telescope in photography is unquestionably due, primarily, to its perfect achromatism. The importance of this has of course been recognized for many years, but I think that the *degree* of the importance, *in photography*, of perfect achromatism has not been appreciated — that the effect of this achromatism in giving great speed as well as great sharpness has not been fully recognized. Hardly less important is the fact that in the case of large instruments much less light is lost, of the wave-lengths which are most effective in photography, by absorption at the silver surfaces of a reflector than by absorption and reflection in an objective.

In the case of the refractor the difficulties due to imperfect achromatism, as well as the percentage of light lost in transmission, increase rapidly with increase of size of the objective. In the case of the reflector, however, a large instrument is as perfectly achromatic as a small one, and the percentage of light lost does not increase with increase of aperture. But the reflecting telescope has not been developed to the state of refinement which has been attained in the case of the refractor. This is probably due, to a large extent, to the fact that the difficulties and peculiarities of the reflector have not been thoroughly understood; at any rate, it is certain that these difficulties have not, in the past, been successfully met. It is almost superfluous to state that the great reflectors of the past, without exception, have been in many respects extremely crude instruments; in all cases without the great rigidity and stability of construction which are absolutely essential to the successful performance of a reflector; and in all cases without the refinement of workmanship, in both optical and mechanical parts, which are attained in the great modern refractors. In saying this I certainly intend no criticism of the able and skilful men who have been the pioneers in the development of the reflecting telescope, and who have contributed so much to both the methods and the results of astronomical observation.

It is safe to assert that the peculiar difficulties of the reflecting telescope are now thoroughly understood, and that all difficulties which relate to its mechanical and optical construction have been successfully solved.

As a result of the improvements and developments in glass-making, in optical work, and in the methods and materials of modern mechanical construction; and as a result, no less, of the experience of those who have both made reflecting telescopes of moderate size and used them successfully in astronomical photography, there can be no doubt whatever that a great reflecting telescope of five or eight feet aperture could now be constructed with all of the refinement of the two-foot reflector or the forty-inch refractor.

The speed of the reflector in the photography of nebulæ is of course due largely to its great angular aperture. All of the reflector photographs which accompany this article, with the exception of that of *Messier* 51, were made with the aperture of the $23\frac{1}{2}$-inch mirror reduced to 18 inches, in order that good definition might be secured over a larger field than is well covered when the full aperture is used. The ratio of focal length to aperture was therefore as $5\frac{1}{6}$ to 1. These photographs

show what can be done with a reflecting telescope of very moderate size (aperture 18 inches, focal length 93 inches) when sufficient care is given to the perfection of the mirrors and mounting, and when an effective method of guiding is employed.

The photograph of the great nebula in *Orion* (Plate XXIII) was obtained with an exposure of one hour. Even with this short exposure faint extensions of the nebula and a great amount of delicate structure in the moderately bright parts are shown, which cannot be detected visually with either the two-foot reflector or the 40-inch refractor. A comparison of this photograph with that of the central part of the same nebula obtained with the forty-inch refractor (Plate XXI), and also with other published photographs of this object obtained with photographic refractors, gives some idea of the great efficiency of a well-made modern reflector of large angular aperture in such work.

The photograph of the great nebula in *Andromeda* (Plate XXIV) was obtained with an exposure of four hours, although one hour's exposure, or less, is sufficient to show the general characteristics of the object well. This is one of the most magnificent examples of a spiral nebula to be found in the heavens, yet its spiral character was never suspected from visual observations. In the original negative the spiral structure is visible almost to the center of the nebula, and the stellar nucleus is distinctly seen. Sharply defined narrow rifts and dark holes near the center are shown on all of the negatives of this object; no trace of these can be detected visually with any telescope.

The photograph of the spiral nebula *Messier* 33 *Trianguli* (Plate XXV) was obtained with an exposure of four hours. This nebula is very large and very faint; the spiral character of its central parts was discovered by Lord Rosse; by far the greater part of the complicated structure shown in the photograph is too faint to be detected visually. While differing greatly in general appearance from the great *Andromeda* nebula, *Messier* 33 resembles the latter in several striking characteristics; in the presence of dark rifts and holes in and near the bright central parts, and in the tendency of its outer branches to break up into stars. The central parts of this object appear decidedly nebulous; the outer parts consist of very faint nebulosity and of numerous curved streams or wisps of nebulous stars; hundreds of these star-like condensations are so distinctly shown on the original negative that they may be well seen even in the half-tone reproduction. There can be no doubt of the physical connection between the nebulosity and the streams of minute stars; this object therefore affords what is apparently a most striking example of a spiral nebula condensing into stars.

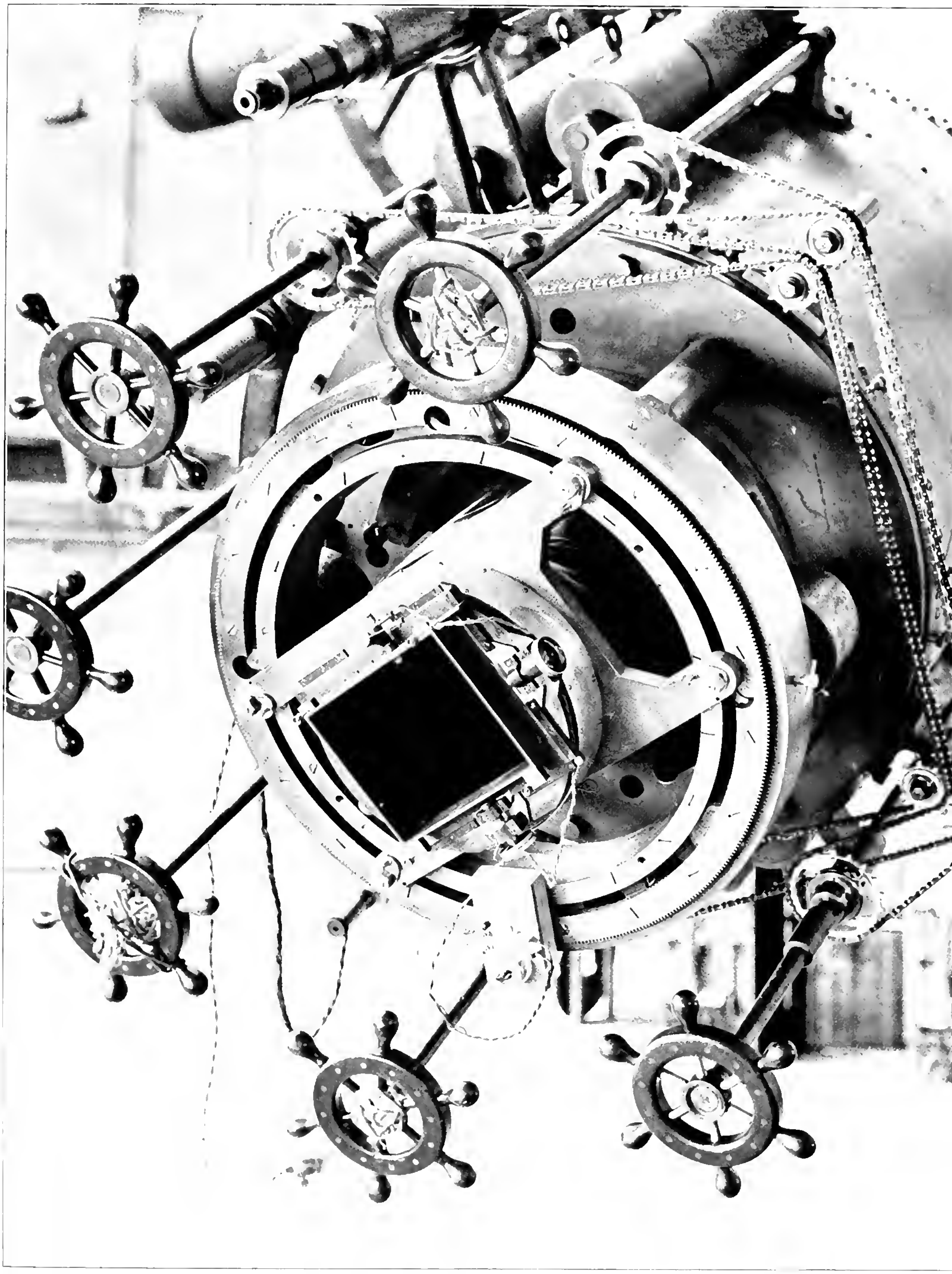
The illustration of the nebulosities in the *Pleiades* (Plate XXVI) is from a negative obtained with an exposure of three and one-half hours. This photograph is extremely difficult to reproduce properly, on account of the great difference in brightness between the bright stars and the faint masses of nebulosity. Some idea of the intricate filamentous structure of these masses may be gained from the half-tone plate. In the original negative, from which I hope a more satisfactory reproduction may yet be secured, the entire field, nearly two degrees square, is covered with a network of filaments, of which those in the southwest part of the photograph, and apparently connected with the great curved mass of streamers about *Merope*, are the most conspicuous. Only the brighter filaments of this vast network are shown in the reproduction.

The photograph of the nebula *N. G. C.* 6960 (Plate XXVII) was obtained with an exposure of four hours, and that of *N. G. C.* 6992 (Plate XXVIII) with an exposure of three hours. These nebulæ are the most remarkable examples of filamentous nebulæ which I have photographed. They lie near together in the Milky Way in the constellation of *Cygnus;* they are apparently only the brightest parts of one great nebula, as extremely faint nebulous masses can be seen in the negatives, extending from one to the other. The nebula *N. G. C.* 6960 apparently lies exactly on the boundary between the dense region of stars to the east (the right-hand side in the illustration) and the region to the west which is comparatively void of stars. Instances of this kind occur again and again, and strongly suggest some intimate physical connection between such nebulæ and the dense masses of stars in their neighborhood. These photographs afford striking illustrations of the wonderful richness and complexity of structure

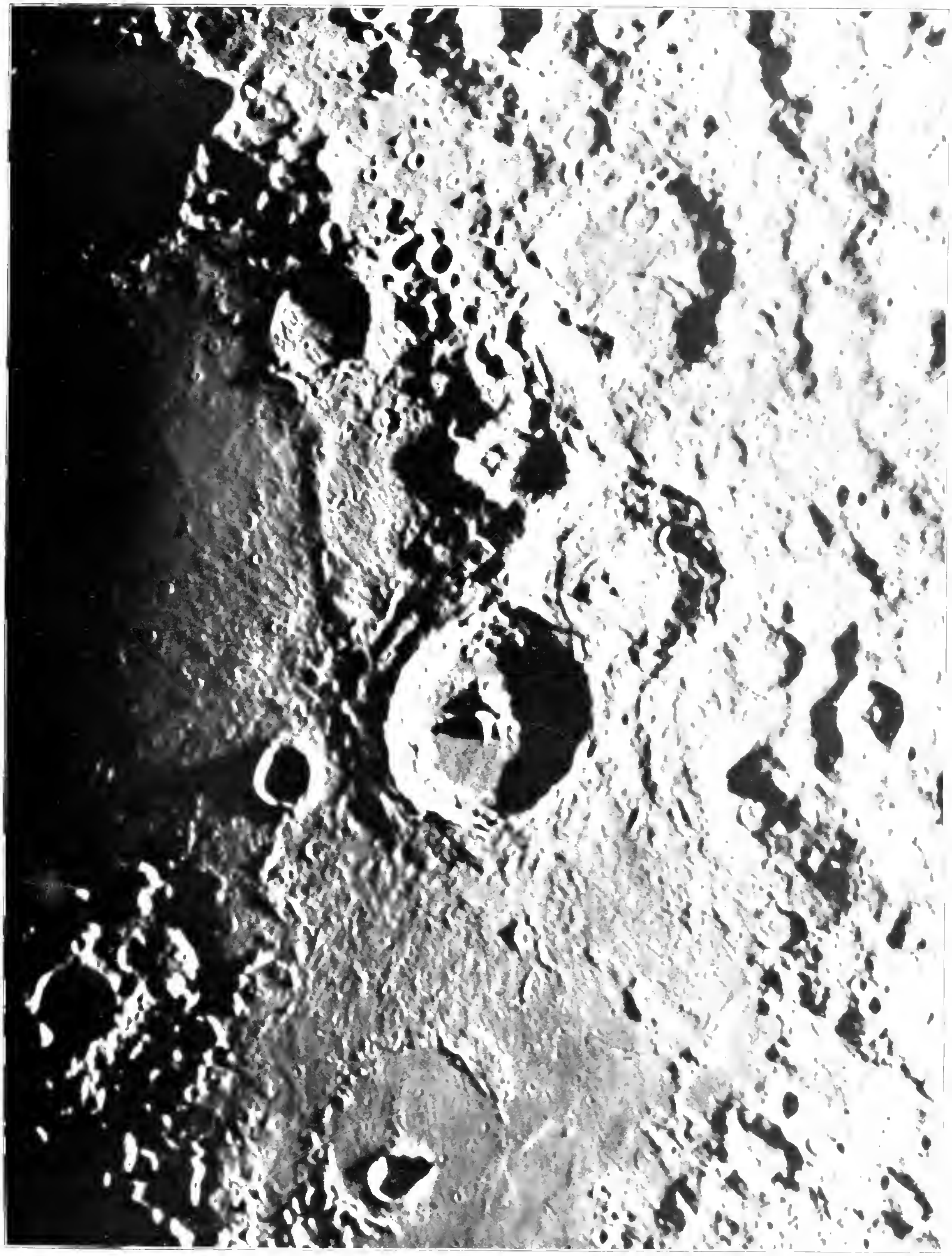
of the nebulæ, and of the importance of photography in the study of these very faint objects. When it is remembered that these photographs, showing such delicacy of detail, are obtained with a reflecting telescope of only eighteen inches aperture and ninety-three inches focal length, we can gain some idea of the results which might be obtained in the photographic study of the nebulæ with a thoroughly well-made reflecting telescope which would be comparable in size, cost, and refinement of workmanship with the great modern refractors.

The photograph of *Messier* 51 (Plate XXIX) was obtained with an exposure of six hours and with an aperture of 22 inches. With this long exposure and large angular aperture a very intense negative was obtained, which shows much exterior nebulosity; the latter is so faint, however, that it is almost entirely lost in the half-tone reproduction. Perhaps the most remarkable part of the very faint outer nebulosity is a great curved mass which forms a continuation of the conspicuous branch of the nebula to the extreme south; this continues toward the east, curves toward the north, and then toward the northwest, and joins the parts of the nebula to the north. The reproduction shows well the details of the two bright main branches of the spiral, and also the faint wisps and filaments between them; the latter are far beyond the reach of all telescopes visually. The faintest stars shown on the original negative are about two magnitudes fainter than those which are at the visual limit of the forty-inch refractor.

I am indebted to Mr. F. G. Pease for able assistance in securing the reflector photographs, and in preparing all of the photographic enlargements for the engraver's use. Great credit is due to the Binner-Wells Co., engravers, for the unusual care and skill with which the photographs have been reproduced.



Large Double-Slide Plate-Carrier Attached to Forty-Inch Refractor



Lunar Crater *Theophilus* and Surroundings

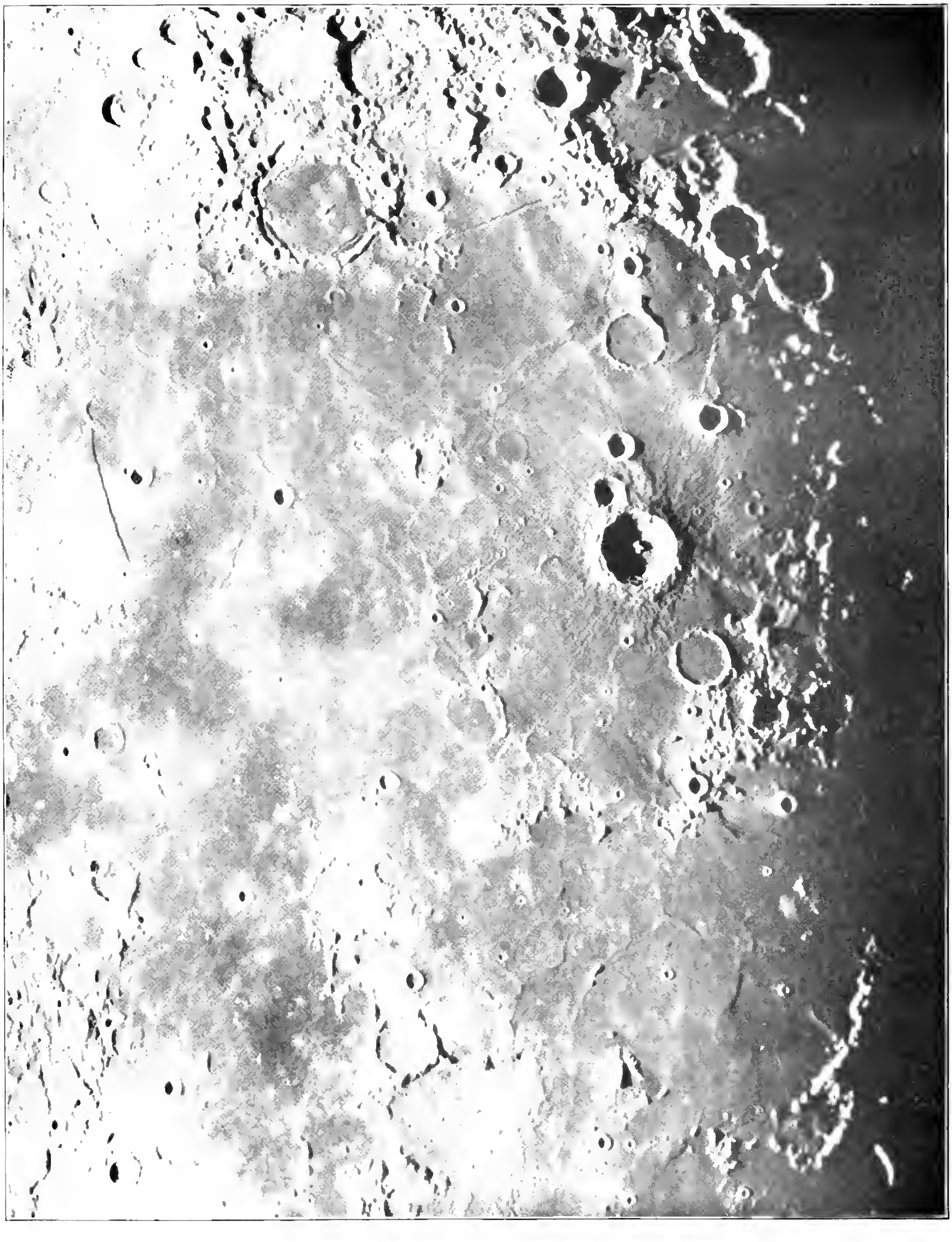
Scale: 1.29 Meters to Moon's Diameter

Mare Serenitatis, Mare Tranquillitatis, and Surroundings

Scale 0.62 Meter to Moon's Diameter

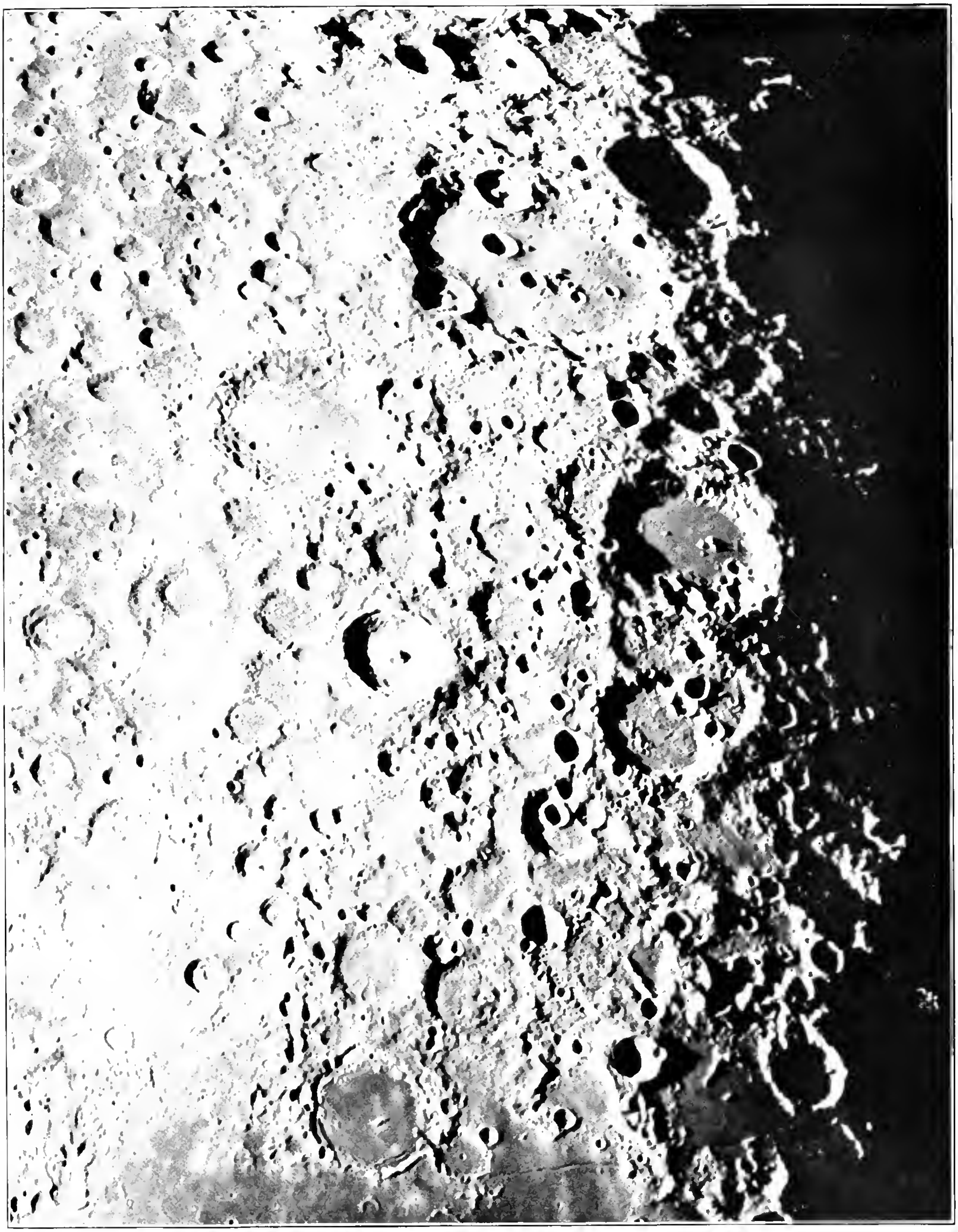
LUNAR CRATER *Copernicus* AND SURROUNDINGS

SCALE 1.02 Meters to Moon's Diameter



Mare Nubium, Bullialdus, etc.

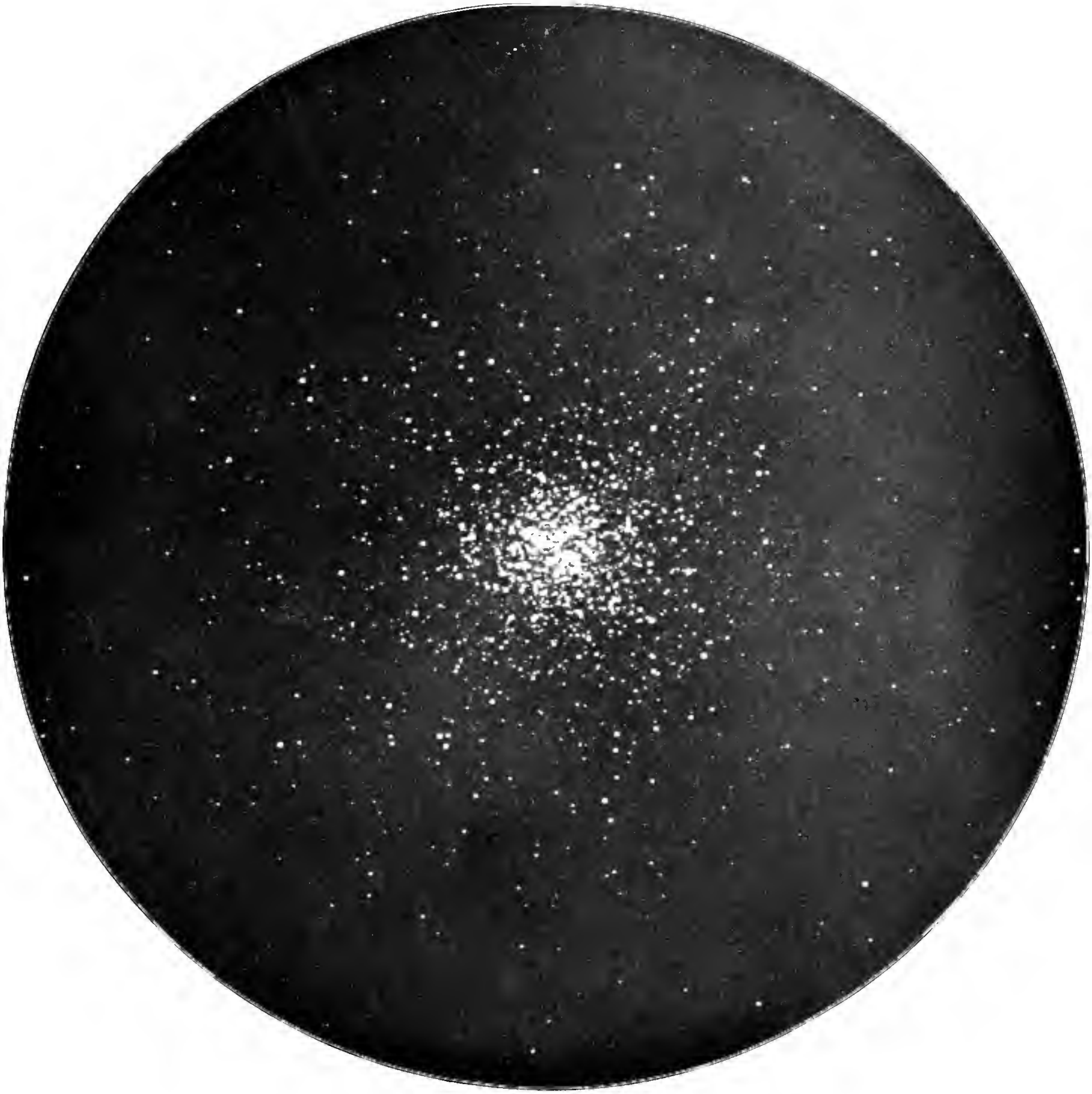
Scale: 0.79 Meter to Moon's Diameter



LUNAR CRATERS *Clavius, Longomontanus, Tycho,* ETC.

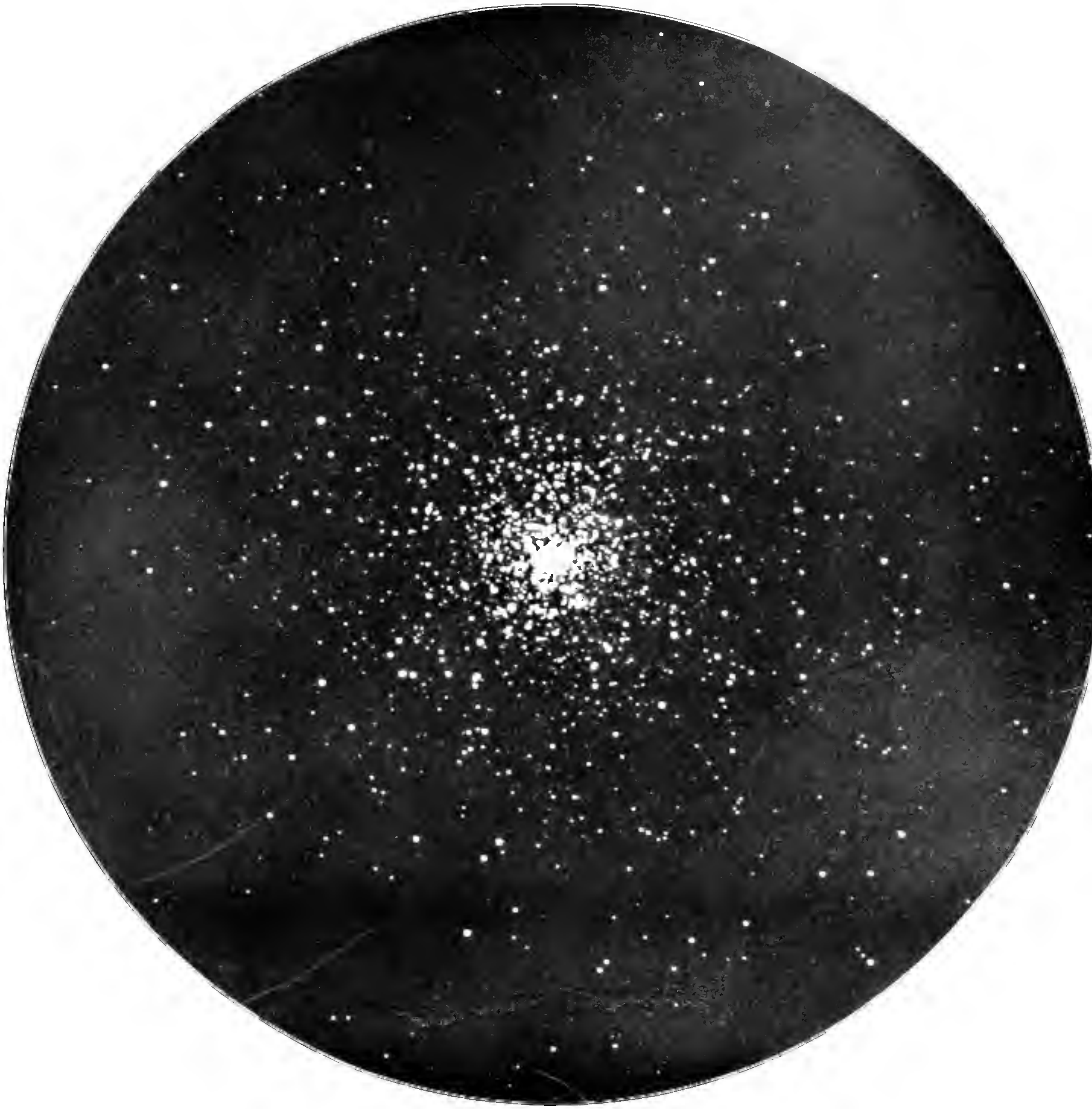
SCALE: 0.79 Meter to Moon's Diameter

SYSTEM OF BRIGHT RAYS ABOUT *Tycho*



Star Cluster *Messier* 13 *Herculis*

Scale: 1mm = 4".66

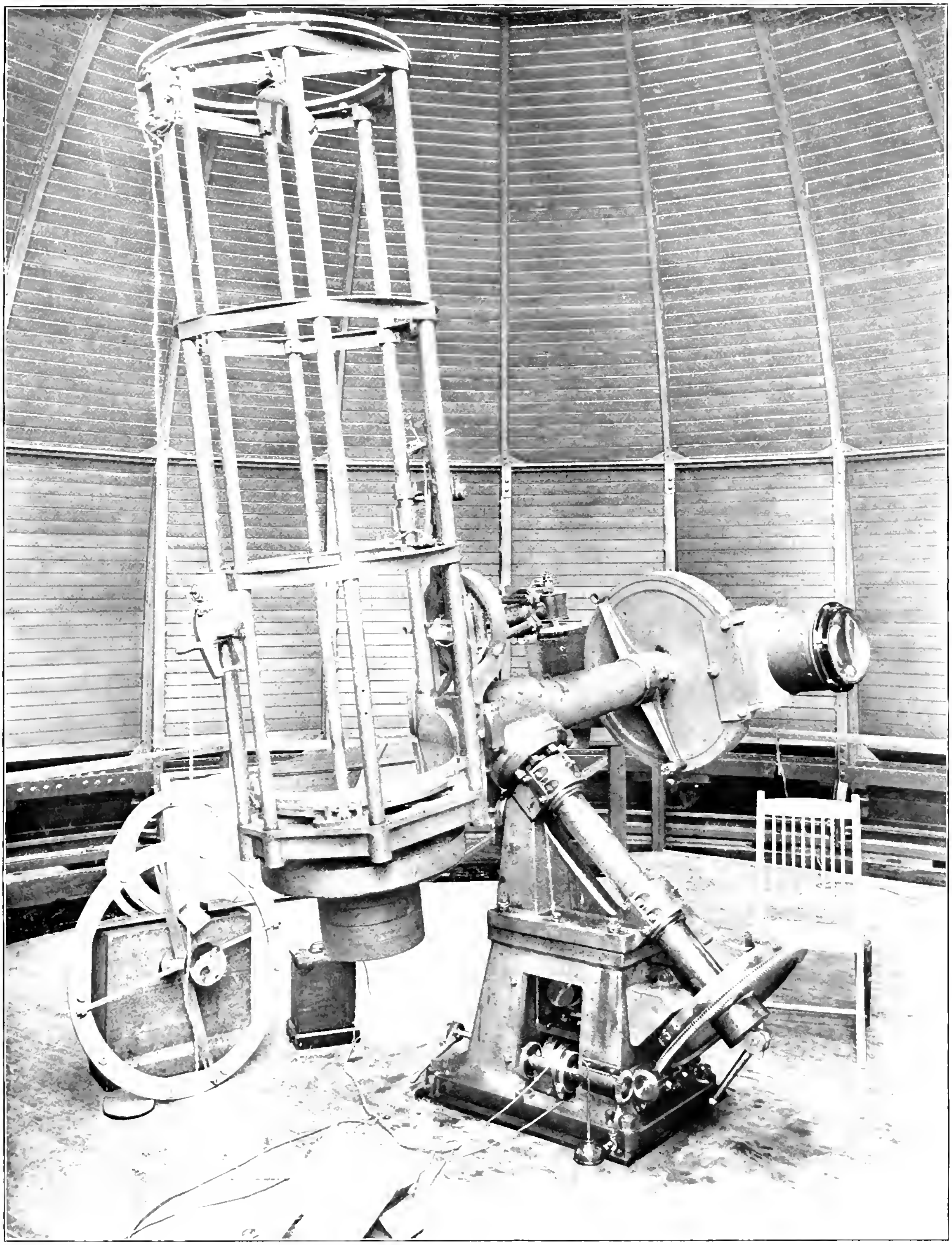


Star Cluster *Messier* 15 *Pegasi*

Scale 1 [illegible] 3"22

CENTRAL PART OF GREAT NEBULA IN *ORION*

SCALE: $1^{mm} = 4.7''$



TWO-FOOT REFLECTING TELESCOPE OF THE YERKES OBSERVATORY

PLATE XXIII

GREAT NEBULA IN *Orion*

October 19, 1901

Great Nebula in Andromeda

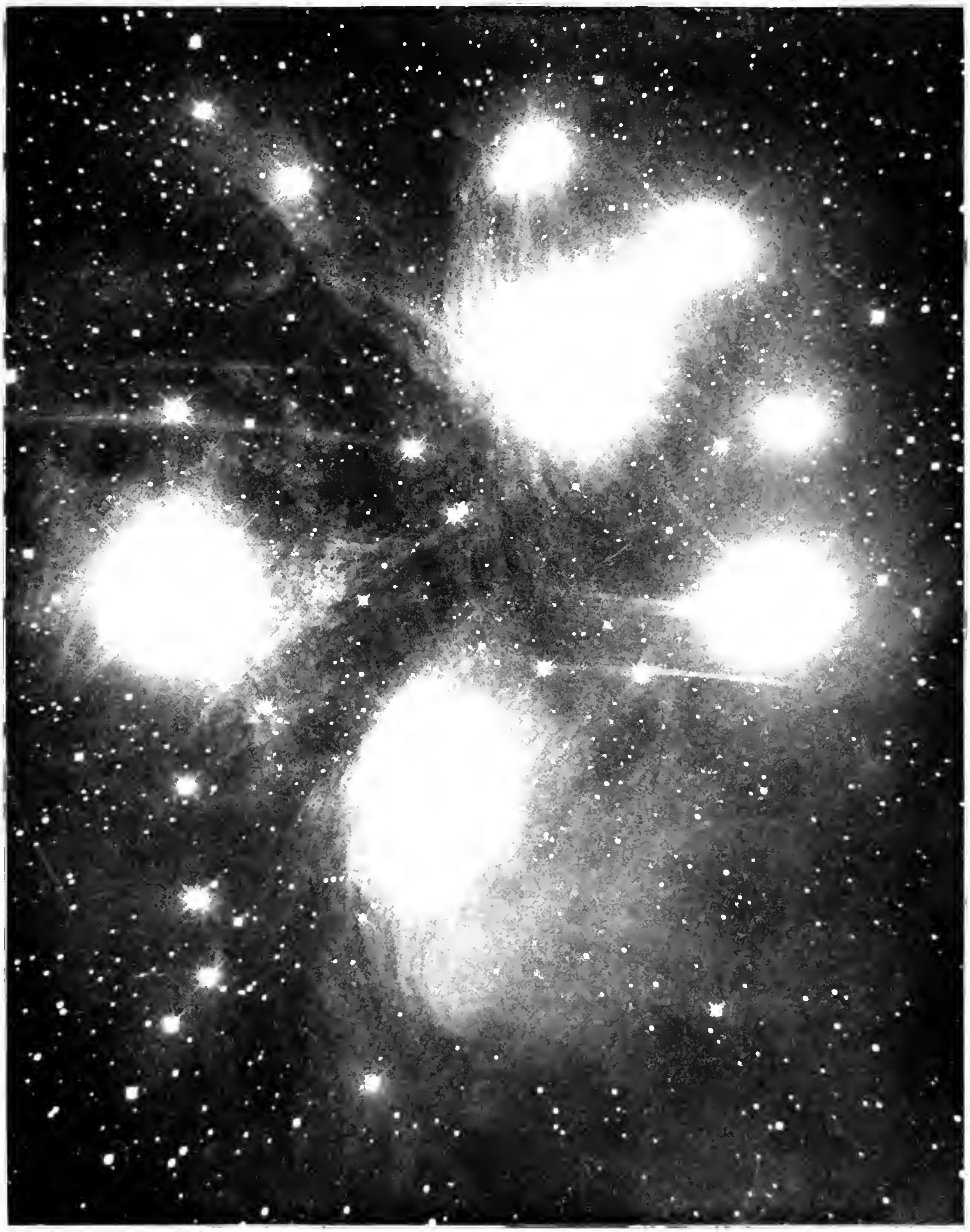
Scale 1

September 18, 1901

Spiral Nebula *Messier 33 Trianguli*

Scale 1 mm. = 15".5

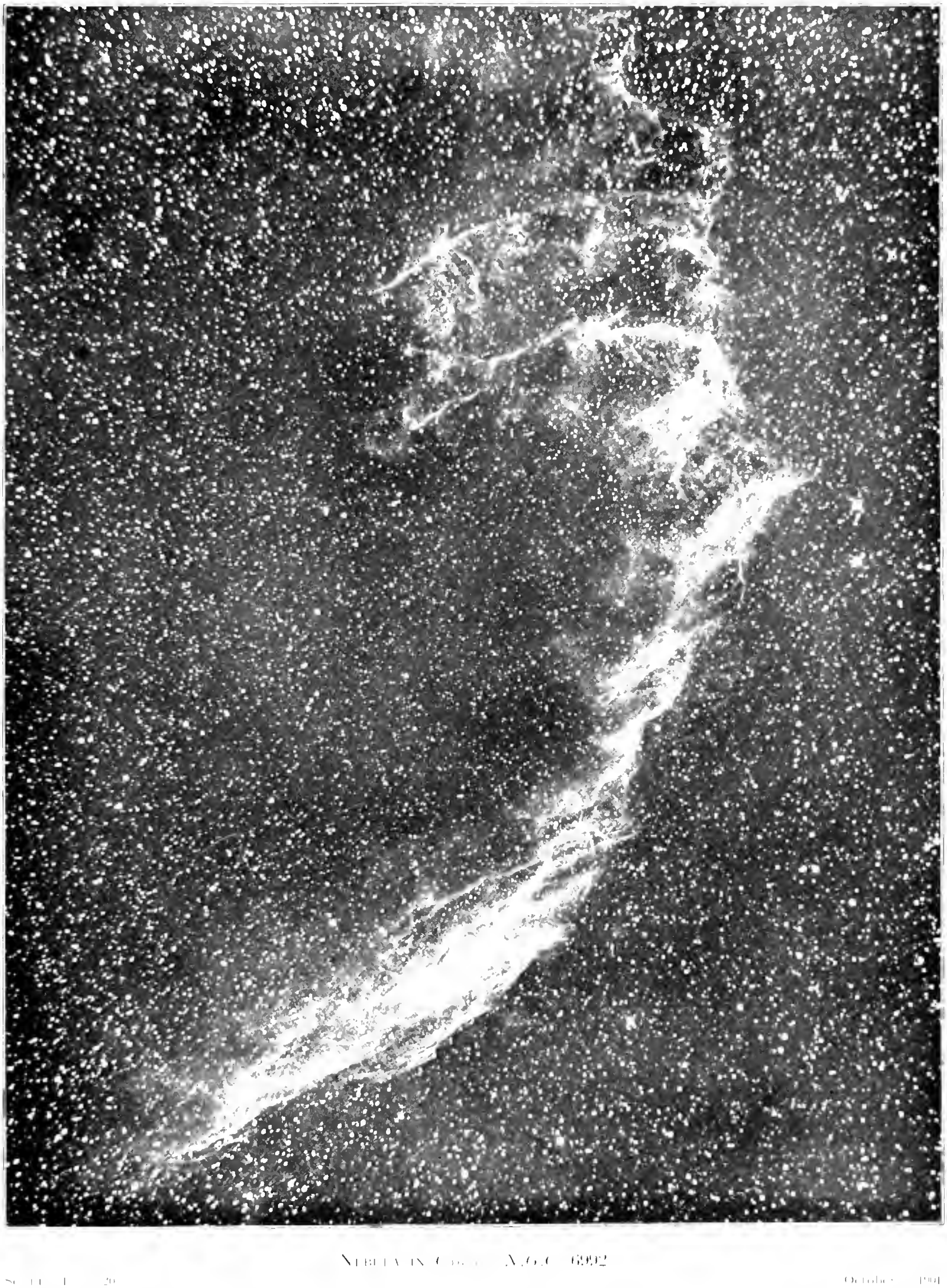
September 1 and 6, 1902



Nebulosity in the *Pleiades*

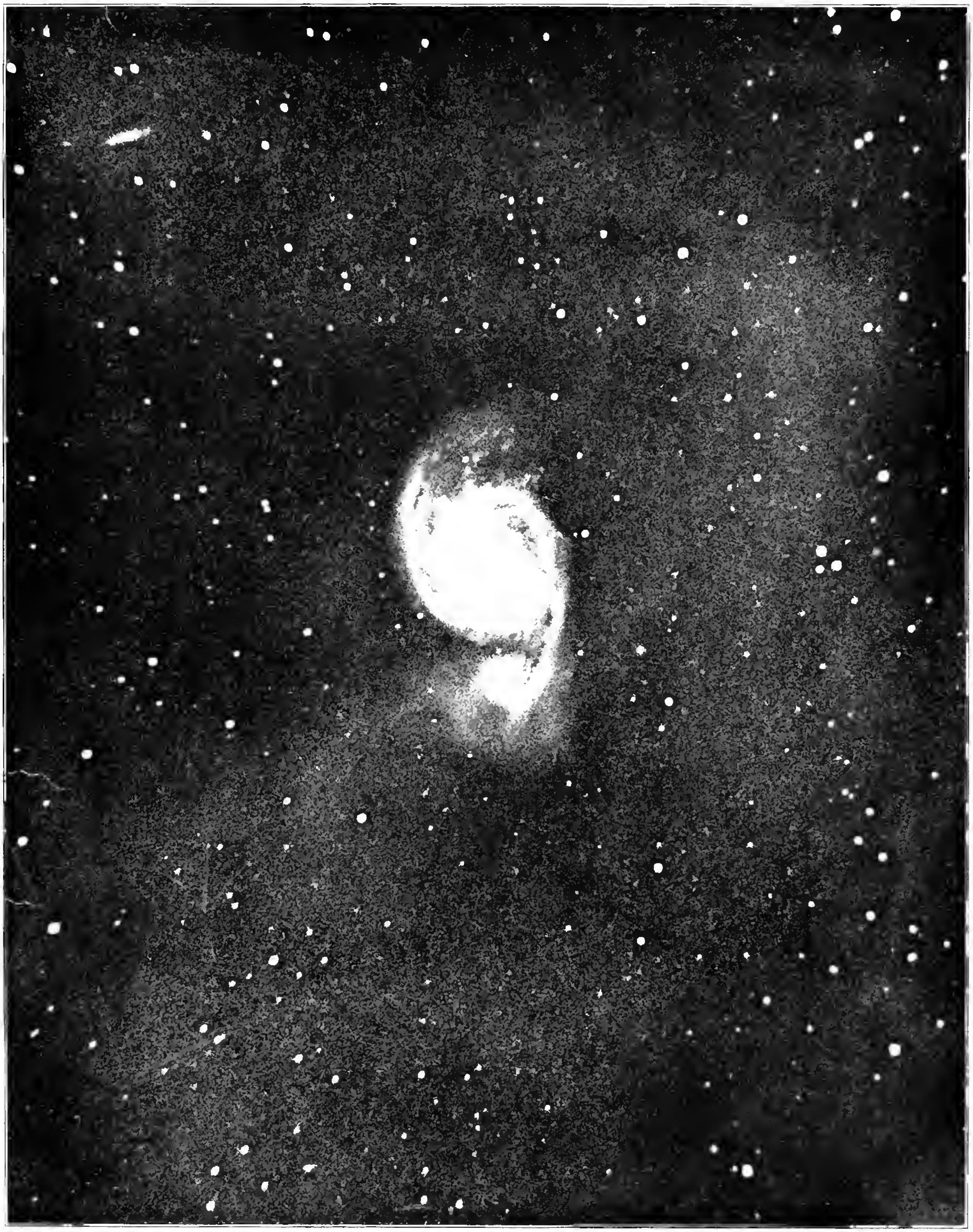
Scale 1 [illegible] 41 October 19, 1901

NEBULA IN CYGNUS. N.G.C. 6960



Nebula in Cygnus N.G.C. 6992

Scale 1 mm = 20″ October [illegible] 1901



Spiral Nebula Messier 51 Canum Venaticorum

Scale 1 mm = 13″.2

June 3, 1902

THE ORBIT OF THE MINOR PLANET (334)

THE ORBIT OF THE MINOR PLANET (334)

Kurt Laves

INTRODUCTION. THE MINOR PLANETS OF THE HILDA TYPE

Of the four principal types of characteristic planets those of the *Hestia* $\left(\mu=\frac{1}{3}\right)$ and *Hecuba* $\left(\mu=\frac{1}{2}\right)$ types have led to frequent and elaborate investigations. The planets of the *Hilda* $\left(\mu=\frac{2}{3}\right)$ and *Thule* $\left(\mu=\frac{3}{4}\right)$ types have so far attracted very little attention. This is due, first, to the paucity of the number of planets of these two groups, and, secondly, to the close proximity of the perturbing planet *Jupiter*, which renders the development of the perturbative function laborious and difficult. The methods best adapted for the planets of the *Hilda* and *Thule* types will most likely be that of Gyldén and the periodic solution method of Poincaré. The planets of the *Hilda* type are four in number: *(153)*, *(190)*, *(334)*, and *(361)*. The characteristic elements of these planets are:[1]

	(153)	*(190)*	*(334)*	*(361)*
n	452″197	452″998	459″742	450″396
ϕ	9° 44′5	9° 19′8	0° 50′4	11° 32′9
i	7° 52′7	6° 6′7	4° 38′1	12° 37′0

The planets of the *Hilda* and *Thule* types are in peculiar contrast to the gaps (lacunes) which occur in the regions of commensurability of the planets of the *Hestia* and *Hecuba* types. Tisserand, Gyldén, Poincaré, and Callandreau have shown that the absence of planets in these regions cannot be explained by an action of *Jupiter* on these planets. Indeed, the orbits of planets which pass through values of the mean daily motion which are commensurable to that of *Jupiter* continue to be stable. In the twenty-fifth chapter of the fourth volume of his *Mécanique céleste* Tisserand has investigated whether or not there are any planets in these two realms, where *Jupiter* will bring about a librational effect. Of the *Hestia* type the planet *(132)* is the only one where libration is likely to occur. Tisserand points to the three planets *(332)*, *(381)*, and *(325)* of the *Hecuba* type which in the future, when their elements will be known with greater accuracy, may prove to be "librational" planets. In the table which Tisserand has given on p. 419 the planet *(132)* is stated to have a mean daily motion of 888″8, which is incorrect and should read 904″. Planet *(332)* is erroneously put in the *Hecuba* group, since it really is a planet of the type $\frac{2}{5}$. Allowing for these changes and employing the elements as they appear in Professor Bauschinger's up-to-date table, there are left, then, three ambiguous planets, namely, *(132)*, *(381)*, and *(325)*. Planet *(132)* has unfortunately not been observed since its first discovery by Watson in 1873; therefore very little weight can be placed upon the accuracy of its elements. As will be shown, it is the only planet of the two types where Tisserand's criterion will bring out a librational effect. The planets *(381)* and *(325)*, discovered in 1894 and 1892 respectively, have been observed in five and four oppositions respectively. Their elements may therefore now be considered to be trustworthy, at least as far as is necessary for the accuracy required by Tisserand's criterion. Neither one of them shows any libration whatever. We have, therefore, as yet to find a "librational" planet belonging to either group. Extending Tisserand's investigations to the planets of the *Hilda* and *Thule* types, we encounter at once planets of a very marked librational character. Tisserand, in

[1] See J. Bauschinger, *Tabellen zur Geschichte und Statistik der kleinen Planeten*, Tabelle II, "Veröffentlichungen des kgl. astronomischen Recheninstituts zu Berlin," No. 16.

deriving his criterion, has taken into account but one term of the perturbative function; he has integrated the differential equation for θ [equation (1) on p. 421 of Vol. IV] as if h were a constant, which it is not; and lastly he has considered the Keplerian ellipse as a sufficient first approximation for the elements. The failure to find librational planets might therefore be considered from the standpoint of the mathematician as an indication that the method is at fault and that instability of the orbits will really take place. Such an argument is contradicted by the existence of librational planets of very marked degree, and that in the closest proximity to the perturbing planet. The attempt has been made to improve Tisserand's method in this respect that not only one of the characteristic perturbative terms is taken into account, but two. Considering the average magnitude of the eccentricity of the orbits involved, it seemed necessary not to neglect the term which carries the square of the eccentricity. It was found that the numerical results thus obtained are very little different from those obtained by Tisserand's original proceeding, but that it is considerably more laborious to obtain them. In what follows the results are given for the planets of the four groups, using Tisserand's criterion without change.

I. THE HESTIA TYPE

Libration takes place if the following inequality is fulfilled:

$$(n_1 - 3n')^2 < \frac{3}{2} m' \frac{n'^2}{a^2} e^2 \sin^2 \frac{\theta_1}{2} \left(21 b^{(3)} + 10 a \frac{d b^{(3)}}{d a} + a^2 \frac{d^2 b^{(3)}}{d a^2} \right) \;;$$

or, reducing it to numbers for $a = \frac{1}{\sqrt[3]{9}}$, we obtain:

$$|n_1 - 3n'| < 52'' e \sin \frac{\theta_1}{2} \;.$$

For the planet *(132)*

$$|n_1 - 3n'| = 6''\!.3 \qquad 52'' e \sin \frac{\theta_1}{2} = 9''\!.8 \;.$$

The inequality is therefore fulfilled, since $6''\!.3 < 9''\!.8$.

The general formulas for planets where $\frac{n'}{n} = \frac{i-1}{i}$ is approximately fulfilled are, i being an integer:

$$\theta = +(i-1)(L-\pi) - i(L'-\pi) \;. \tag{1}$$

$$R = -\frac{k^2 m'}{2a'} (2i A^{(i)} - A_1^{(i)}) \cos (iL' - (i-1)L - \pi) \;. \tag{2}$$

$$h^2 = 3(i-1)(2i A^{(i)} + A_1^{(i)}) \frac{n'^2 e}{a^2} \;. \tag{3}$$

$$\frac{d^2\theta}{dt^2} = -\frac{1}{2} m' h^2 \sin \theta \;. \tag{4}$$

Libration takes place if

$$\left| n_1 - \frac{i}{i-1} n' \right| < \frac{h}{i-1} \cos \frac{\theta_1}{2} \sqrt{2m'} \;. \tag{5}$$

Putting $i = 2, 3, 4$ into these formulas, we obtain the formulas that hold for the *Hecuba*, *Hilda*, and *Thule* types respectively.

II. THE HECUBA TYPE

Equation (5) becomes

$$|n_1 - 2n'| < 56'' \sqrt{e} \cos \frac{\theta_1}{2} \;.$$

For planet *(325)* the inequality becomes $16''\!.6 < 4''\!.0$.

For planet *(381)* the inequality becomes $21''\!.4 < 19''\!.4$.

Both of these, therefore, fail to be "librational" planets.

III. THE HILDA TYPE

Equation (2) becomes

$$R = -\frac{k^2 m'}{2a'} e \left(6b^{(3)} + a\frac{db^{(3)}}{da}\right) \cos(2L - 3L' + \pi) .$$

Equation (5) becomes

$$\left| n_1 - \frac{3}{2}n' \right| < 58\overset{''}{.}67 \sqrt{e} \cos\frac{\theta_1}{2} .$$

Applying this to the four planets, we obtain

	(153)	(190)	(334)	(361)
$n_1 - \frac{3}{2}n'$	3.51	4.31	11.05	1.70
$58\overset{''}{.}67 \sqrt{e} \cos\frac{\theta_1}{2}$	23.89	22.91	5.70	22.39

With the exception of *(334)*, all of these planets have a *marked* libration.

IV. THE THULE TYPE

The inequality (5) reduced to numbers is

$$\left| n_1 - \frac{4}{3}n' \right| < 62\overset{''}{.}0 \sqrt{e} \cos\frac{\theta_1}{2} .$$

For *Thule* $n_1 - \frac{4}{3}n'$ is $= 4\overset{''}{.}35$, while $62'' \sqrt{e} \cos\frac{\theta_1}{2} = 18\overset{''}{.}39$, which shows that libration will take place.

THE DEVELOPMENT OF THE PERTURBATIVE FUNCTION

The minor planet *(334)* has been named *Chicago* by Professor M. Wolf of Heidelberg, in commemoration of the conference of astronomers and mathematicians held during the World's Exposition in the city of Chicago. The planet is marked for the small eccentricity and inclination of the orbit. It therefore suggested at once the application of Le Verrier's method of general perturbations. In a course of lectures on general perturbations given by the writer in the spring of 1896 the planet was used as an example for illustrating certain modes of computation. At that time but a limited number of observations was known, from which an orbit had been derived by Professor Berberich. The mean motion given in this system of elements was used in the computations. It was soon realized that in order to accomplish something by means of the calculations carried on to some extent by the writer and Professor Moulton in 1896, the perturbative function would have to be extended far beyond the original scope. For a few years the computations were allowed to rest and when taken up again by the writer they were continued with the same value of the mean daily motion, since a recomputation of the previous work seemed unnecessary. For a determination of the mean value of the major axis the set of available observations seemed insufficient. It was therefore argued that if osculating elements were to be used, an epoch of the elements could be determined in such a manner as to bring the value of the major axis used in the computations as near as possible to the major axis of the epoch to be selected. By means of special perturbations the change of the major axis between 1897 and 1894 due to the action of Jupiter was determined, and it was found that the major axis passed, during this interval of time, through the value assumed in the computations. The tables constructed will be of usefulness, too, if at some future epoch new tables of the planet shall be constructed, even if the mean value of the major axis shall appreciably differ from the value employed here. Indeed, by a differential method the change can be taken

into account without very much labor. Pains have been taken to avoid errors in the computations. The coefficients $b^{(i)}$, $b_1^{(i)}$, $b_2^{(i)}$, $c^{(i)}$, $c_1^{(i)}$ from $i=0$ to $i=15$ and the quantities which depend only upon these were computed independently by Mr. Moulton and myself. The other coefficients were almost all of them checked by a repeated calculation in which the calculating machine was used. To enable a checking of any part of the work all the necessary quantities are given from the beginning. It may prove necessary in the second part of this investigation, which will be published at an early date, to add a number of terms which at the present state of the work seemed to be negligible. The planet has been observed in eight oppositions, nine oppositions having occurred since its discovery. It is to be hoped that it will prove in the future to be an object from which much valuable information may be obtained, a new determination of the mass of Jupiter appearing to be of the most immediate importance.

In developing the perturbative function the value of $\alpha = \frac{a}{a'}$ was asssumed to be 0.7543102 $\log \alpha = 9.8775500$.

The development of this function necessitates the calculation of the coefficients of the Fourier series into which $(1 + \alpha^2 - 2\alpha \cos \psi)^{-s}$ is to be developed, when s takes the values $\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}$. The designations used in what follows are those of Le Verrier (see *Annales de l'Observatoire de Paris*, Vol. X). We therefore put

$$
\begin{aligned}
(1+\alpha^2-2\alpha\cos\psi)^{-\frac{1}{2}} &= \sum_0^\infty b^{(i)} \cos i\psi \;, \\
(1+\alpha^2-2\alpha\cos\psi)^{-\frac{3}{2}} &= \sum c^{(i)} \cos i\psi \;, \\
(1+\alpha^2-2\alpha\cos\psi)^{-\frac{5}{2}} &= \sum e^{(i)} \cos i\psi \;, \\
(1+\alpha^2-2\alpha\cos\psi)^{-\frac{7}{2}} &= \sum f^{(i)} \cos i\psi \;.
\end{aligned}
\tag{1}
$$

Only one-half of the absolute terms are to be taken in these developments.

Each of the coefficients $b^{(i)}$, $c^{(i)}$, $e^{(i)}$, $f^{(i)}$ is given by means of power series in α, the coefficients of which depend upon the respective values of s. In the second volume of the Annales Le Verrier has given these coefficients of the various powers of α with sufficient accuracy. Recursion formulas are easily obtainable by means of which the higher $b^{(i)}$, $c^{(i)}$ . . may be calculated when the lower ones are known. On account of the slow convergence of the series it was deemed necessary to compute the coefficients $b^{(i)}$, and $c^{(i)}$ up to and including the term for which i is equal to 30.

In Le Verrier's method the perturbative function is developed, by Taylor's principle, by starting from the circular form of the orbit. Owing to the small value of the eccentricity of (*334*), a close approach to the true orbit should be obtained by stopping at the fourth degree terms in the periodic terms, and carrying the development up to the sixth degree in the secular terms.

$$R_{01} = (r^2 + r'^2 - 2rr' \cos\psi)^{-\frac{1}{2}} - \frac{r\cos\psi}{r'^2}$$

is the expression for the perturbative function. From the development given above the A^i, B^i, C^i, D^i coefficients are derived by means of the formulas:

$$
\begin{aligned}
(a^2+a'^2-2aa'\cos\psi)^{-\frac{1}{2}} &= \frac{1}{2}\sum A^{(i)} \cos i\psi \;, \\
aa'\,(a^2+a'^2-2aa'\cos\psi)^{-\frac{3}{2}} &= \frac{1}{2}\sum B^{(i)} \cos i\psi \;, \\
a^2a'^2\,(a^2+a'^2-2aa'\cos\psi)^{-\frac{5}{2}} &= \frac{1}{2}\sum C^{(i)} \cos i\psi \;.
\end{aligned}
\tag{2}
$$

Comparing set (1) with (2) it follows that we have:

$$a'A^{(i)} = b^{(i)} \qquad a'B^{(i)} = a\,c^{(i)}$$

$$a'A_1^{(i)} = b_1^{(i)} \qquad a'B_1^{(i)} = a\,(c_1^{(i)} + c^{(i)})$$

$$a'A_2^{(i)} = \frac{1}{2}\,b_2^{(i)} \qquad a'B_2^{(i)} = \frac{a}{2}\,(c_2^{(i)} + 2c_1^{(i)}$$

$$a'A_3^{(i)} = \frac{1}{2.\,3}\,b_3^{(i)} \qquad a'B_3^{(i)} = \frac{a}{2.\,3}\,(c_3^{(i)} + 3c_2^{(i)})$$

$$a'A_4^{(i)} = \frac{1}{2.\,3.\,4}\,b_4^{(i)} \qquad a'C^{(i)} = a^2 e^{(i)}$$

$$a'C_1^{(i)} = a^2\,(e_1^{(i)} + 2e^{(i)})$$

$$a'A_5^{(i)} = \frac{1}{2.\,3.\,4.\,5}\,b_5^{(i)}$$

$$a'E^{(i)} = \frac{1}{2}\,(a'B^{(i-1)} + a'B^{(i+1)})$$

$$a'G^{(i)} = \frac{3}{8}\,(a'C^{(i-2)} + 4a'C^{(i)} + a'C^{(i+2)})$$

$$a'L^{(i)} = \frac{3}{4}\,(a'C^{(i-2)} + a'C^{(i)})$$

The development for $R_1 = (r^2 + r'^2 - 2rr' \cos\psi)^{-\frac{1}{2}}$ will be obtained by means of the foregoing formulas; this being done, R_{01} is deduced from it. Those coefficients of R_{01} which are affected by the development of $\frac{r\cos\psi}{r'^2}$ are given at the bottom of each table with the proper designation. In the six differential equations for the elements will enter the partial differerential quotients of R_{01} with respect to the various elements involved. For all of them except $\frac{\partial R_{01}}{\partial a}$ the coefficients that hold for R_{01} will be the same. It is therefore necessary to give for $\frac{\partial R_{01}}{\partial a}$ a special development. The calculation for the coefficients of this quantity rests upon the following formulas, which closely resemble the foregoing formulas:

$$a'a\frac{dA^{(i)}}{da} = a'A_1^{(i)} \qquad a'a\frac{dA_4^{(i)}}{da} = 5a'A_5^{(i)} + 4a'A_4^{(i)}$$

$$a'a\frac{dA_1^{(i)}}{da} = 2a'A_2^{(i)} + a'A_1^{(i)} \qquad a'a\frac{dB^{(i)}}{da} = a'B_1^{(i)}$$

$$a'a\frac{dA_2^{(i)}}{da} = 3a'A_3^{(i)} + 2a'A_2^{(i)} \qquad a'a\frac{dB_1^{(i)}}{da} = 2a'B_2^{(i)} + a'B_1^{(i)}$$

$$a'a\frac{dA_3^{(i)}}{da} = 4a'A_4^{(i)} + 3a'A_3^{(i)}$$

$$a'a\frac{dB_2^{(i)}}{da} = 3a'B_3^{(i)} + 2a'B_2^{(i)}$$

$$a'a\frac{dC^{(i)}}{da} = a'C_1^{(i)}$$

$$a'a\frac{dC_1^{(i)}}{da} = 2a'C_2^{(i)} + a'C_1^{(i)}$$

$$a'a\frac{dE^{(i)}}{da} = \frac{1}{2}\left(a'a\frac{dB^{(i-1)}}{da} + a'a\frac{dB^{(i+1)}}{da}\right)$$

$$a'a\frac{dG^{(i)}}{da} = \frac{3}{8}\left(a'a\frac{dC^{(i-2)}}{da} + 4a'a\frac{dC^{(i)}}{da} + a'a\frac{dC^{(i+2)}}{da}\right)$$

$$a'a\frac{dL^{(i)}}{da} = \frac{3}{4}\left(a'a\frac{dC^{(i-2)}}{da} + a'a\frac{dC^{(i)}}{da}\right)$$

TABLE I

i	$b_0^{(i)}$	$b_1^{(i)}$	$b_2^{(i)}$	$b_3^{(i)}$	$b_4^{(i)}$	$b_5^{(i)}$	$b_6^{(i)}$
0	2.441305	1.443403	5.590232	34.898984	327.1807	4050.409	62512.41
1	1.016735	1.913511	5.497506	35.271067	327.9349	4057.947	62583.87
2	0.596121	1.785029	6.099221	35.749825	331.2201	4079.383	63106.04
3	0.381915	1.549698	6.483219	37.527031	336.3891	4117.862	63128.86
4	0.255109	1.300851	6.552158	39.806480	346.1931	4174.097	....
5	0.174627	1 070263	6.351655	41.821026	360.6489	4258.352	....
6	0.121483	0.868749	5.958702	43.089983	377.7701	4378.645	....
7	0.085489	0.698331	5.447238	43.404727	394.8075	4534.445	....
8	0.060680	0.557208	4.877527	42.753952	409.1497	4716.083	....
9	0.043359	0.442019	4.294311	41.247667	418.8124	4899.008	....
10	0.031148	0.348991	3.728425	39.057161	422.5994	5089.724	....
11	0.022475	0.274477	3.199295	36.374347	420.0530	5236.467	....
12	0.016276	0.215164	2.718241	33.37593	411.4613	5355.954	....
13	0.011823	0.168201	2.289570	30.23708	397.1126	5410.922·	....
14	0.008612	0.131167	1.914574	27.06107	378.7607	5406.813	....
15	0.006287	0.102078	1.590132	23.99735	355.6490	5355.452	....
16	0.004599	0.079289	1.3137	21.0520	....	....	....
17	0.003370	0.061493	1.0789	18.3651	....	....	....
18	0.002473	0.047622	0.8831	15.8222	....	....	....
19	0.001817	0 036835	0.7186	13.656	....	....	....
20	0.001337	0.028450	0.5840	11.554	....	....	....
21	0.000985	0.021967	0.4711	9.942	....	....	....
22	0.000726	0.016944	0.3810	8.214	....	....	....
23	0.000536	0.013050	0.3050	7.136	....	....	....
24	0 000396	0.010066	0.2450	5.712	....	....	....
25	0.000293	0.007735	0.1956	5.048	....	....	....
26	0.000217	0.005971	0.1551	3.922	....	....	....
27	0.000161	0.004575	0.1246	3.476	....	....	....
28	0.000120	0.003527	0.0964	2.754	....	....	....
29	0.000090	0.002687	0.0791	2.281	....	....	....
30	0.000068	0.002065	0.0587	2.066	....	....	....

i	$c_0^{(i)}$	$c_1^{(i)}$	$c_2^{(i)}$	$c_3^{(i)}$	$e_0^{(i)}$	$e_1^{(i)}$	
0	12.36175	68.6237	621.7857	7553.544	134.8231	1582.967	....
1	11.23813	68.4992	618.8126	7538.537	132.0236	1570.668	....
2	9.66595	66.2459	611.9514	7489.341	124.8907	1532.359	....
3	8.0770	62.1949	599.078	7408.474	114.9379	....	....
4	6.6281	56.9571	578.959	7289.902	103.4751	....	....
5	5.3714	51.1037	551.770	7128.134	91.5053	....	....
6	4.3130	45.0838	518.578	6916.374	....	....	....
7	3.4387	39.2155	480.757	....	....	....	....
8	2.7263	33.7093	440 218	....	....	....	....
9	2.1517	28.6831	398.372	....	....	....	....
10	1.6917	24.1970	356.748	....	....	....	....
11	1.3258	20.2550	316.409	....	....	....	....
12	1.0362	16.8471	278.092	....	....	....	....
13	0.8079	13 9271	242.629	....	....	....	....
14	0.6286	11.4574	209.897	....	....	....	....
15	0.4882	9.407	180.256	....	....	....	....
16	0.3786	......	....	....	....	....	....
17	0.2932	......	....	....	....	....	....
18	0.2268	......	....	....	....	....	....
19	0.1751	......	....	....	....	....	....
20	0.1350	......	....	....	....	....	....
21	0.1041	......	....	....	....	....	....
22	0 0802	......	....	....	....	....	....
23	0.0616	......	....	....	....	....	....
24	0.0473	......	....	....	....	....	....
25	0.0363	......	....	....	....	....	....
26	0.0279	......	....	....	....	....	....
27	0.0212	......	....	....	....	....	....
28	0.0161	......	....	....	....	....	....
29	0.0122	......	....	....	....	....	....
30	0.0092	......	....	....	....	....	....

TABLE II

i	$a'A^{(i)}$	$a'A_1^{(i)}$	$a'A_2^{(i)}$	$a'A_3^{(i)}$	$a'A_4^{(i)}$	$a'A_5^{(i)}$	$a'A_6^{(i)}$	$a'B^{(i)}$	$a'B_1^{(i)}$	$a'B_2^{(i)}$	$a'B_3^{(i)}$	$a'C^{(i)}$
0	2.441305	1.443403	2.795116	5.816497	13.63253	33.7534	86.823	9.3245	61.0871	286.2732	1184.125	76.7122
1	1.016735	1.913541	2.748753	5.878511	13.66395	33.8162	86.923	8.4770	60.1466	285.0504	1181.117	75.1193
2	0.596121	1.785029	3.049610	5.958304	13.80084	33.9949	87.647	7.2911	57.2610	282.2646	1172.344	71.0608
3	0.381915	1.549698	3.241609	6.254505	14.01621	34.3155	87.679	6.0926	53.0066	272.860	1157.323	65.398
4	0.255109	1.300851	3.276079	6.634413	14.42472	34.7841	......	4.9996	47.9630	261.321	1134.829	58.876
5	0.174627	1.070263	3.175827	6.970171	15.02704	35.4863	......	4.0508	42.5997	246.651	1104.237	52.065
6	0.121483	0.868749	2.979351	7.181664	15.74044	36.4887	......	3.2533	37.2605	221.592	1065.096	......
7	0.085489	0.698334	2.723619	7.234121	16.41261	37.7870	......	2.5938	32.1745	210.900	......	......
8	0.060680	0.557208	2.438763	7.125658	17.04793	39.3007	......	2.0565	27.4837	191.457	......	......
9	0.043359	0.442019	2.147155	6.874611	17.41283	40.8251	......	1.6231	23.2590	171.507	......	......
10	0.031148	0.348991	1.864212	6.509527	17.69258	42.4144	......	1.2761	19.5281	152.805	......	......
11	0.022475	0.274477	1.599647	6.062391	17.46452	43.6372	......	1.0001	16.2786	134.614	......	......
12	0.016276	0.215164	1.359120	5.562655	17.22759	44.6329	......	0.7816	13.4896	117.592	......	......
13	0.011823	0.168201	1.144785	5.039513	16.50868	45.0910	......	0.6094	11.1148	102.014	......	......
14	0.008612	0.131167	0.957287	4.510178	15.86506	45.0568	......	0.4742	9.1166	87.806	......	......
15	0.006287	0.102078	0.795066	3.999559	......	44.6288	......	0.3682	......	75.080	......	......
16	0.004599	0.079289	0.65685	3.5087	......	......	......	0.2856	......	......	......	......
17	0.003370	0.061493	0.53947	3.0608	......	......	......	0.2212	......	......	......	......
18	0.002473	0.047622	0.44155	2.6367	......	......	......	0.1711	......	......	......	......
19	0.001817	0.036835	0.3593	2.2760	......	......	......	0.1321	......	......	......	......
20	0.001337	0.028450	0.2920	1.9257	......	......	......	0.1018	......	......	......	......
21	0.000985	0.021967	0.2355	1.6570	......	......	......	0.0785	......	......	......	......
22	0.000726	0.016944	0.1905	1.369	......	......	......	0.0605	......	......	......	......
23	0.000536	0.013050	0.1525	1.189	......	......	......	0.0465	......	......	......	......
24	0.000396	0.010066	0.1225	0.952	......	......	......	0.0357	......	......	......	......
25	0.000293	0.007735	0.0978	0.841	......	......	......	0.0274	......	......	......	......
26	0.000217	0.005971	0.0775	0.654	......	......	......	0.0210	......	......	......	......
27	0.000161	0.004575	0.0623	0.579	......	......	......	0.0160	......	......	......	......
28	0.000120	0.003527	0.0482	0.459	......	......	......	0.0121	......	......	......	......
29	0.000090	0.002687	0.0395	0.380	......	......	......	0.0092	......	......	......	......
30	0.000068	0.002065	0.0298	0.344	......	......	......	0.0069	......	......	......	......

i	$a'a\frac{dA^{(i)}}{da}$	$a'a\frac{dA_1^{(i)}}{da}$	$a'a\frac{dA_2^{(i)}}{da}$	$a'a\frac{dA_3^{(i)}}{da}$	$a'a\frac{dA_4^{(i)}}{da}$	$a'a\frac{dB^{(i)}}{da}$	$a'a\frac{dB_1^{(i)}}{da}$	$a'a\frac{dB_2^{(i)}}{da}$	$a'a\frac{dE^{(i)}}{da}$	$a'a\frac{dE_1^{(i)}}{da}$	$a'a\frac{dE_2^{(i)}}{da}$	
0	1.443403	7.033635	23.039723	71.979611	223.2871	61.0871	633.6278	4124.921	60.1466	630.247	4113.451	......
1	1.913541	7.411047	23.133039	72.291333	223.7368	60.1466	630.2333	4113.452	59.1740	627.711	4103.241	......
2	1.785029	7.884250	23.974133	73.078272	225.1779	57.2610	621.7829	4081.56	56.5766	616.614	4115.570	......
3	1.549698	8.032917	25.246731	74.828355	226.6423	53.0066	602.981	4117.69	52.6120	598.719	4004.345	......
4	1.300851	7.853009	26.455397	77.602119	231.6194	47.9630	575.649	3927.13	47.8032	572.123	3961.801	......
5	1.070263	7.421918	27.262168	81.018673	237.5397	42.5997	541.265	3806.01	42.6115	530.716	3782.800	......
6	0.868749	6.827451	27.503694	84.506752	245.4053	37.2605	485.784	3638.47	37.3871	500.162	......	......
7	0.698334	6.145572	27.149601	87.352803	254.5854	32.1745	459.060	......	32.3721	450.436	......	......
8	0.557208	5.434735	26.254501	89.568894	264.7029	27.4837	415.088	......	27.7167	409.779	......	......
9	0.442019	4.736330	24.918144	90.275153	273.7668	23.2590	360.498	......	23.5019	371.978	......	......
10	0.348991	4.077416	23.257006	90.298901	282.8423	19.5281	328.869	......	19.7688	324.647	......	......
11	0.274477	3.473772	21.386468	88.045253	288.0441	16.2786	288.756	......	16.5088	290.166	......	......
12	0.215164	2.933405	19.406206	85.598325	292.0749	13.4896	251.463	......	13.6967	253.137	......	......
13	0.168201	2.457771	17.408109	81.153259	291.4897	11.1148	217.518	......	11.3031	219.095	......	......
14	0.131167	2.045741	15.445108	76.990786	......	9.1166	186.727	......	......	188.397	......	......
15	0.102078	1.692210	13.588809	......	......	......	159.277	......	......	......	......	......
16	0.079289	1.3930	11.8398	......	......	......	......	......	......	......	......	......
17	0.061493	1.1404	10.2613	......	......	......	......	......	......	......	......	......
18	0.047622	0.9307	8.7932	......	......	......	......	......	......	......	......	......
19	0.036835	0.7554	7.5466	......	......	......	......	......	......	......	......	......
20	0.028450	0.6124	6.3611	......	......	......	......	......	......	......	......	......
21	0.021967	0.4931	5.4421	......	......	......	......	......	......	......	......	......
22	0.016944	0.3979	4.4883	......	......	......	......	......	......	......	......	......
23	0.013050	0.3180	3.8720	......	......	......	......	......	......	......	......	......
24	0.010066	0.2551	3.1010	......	......	......	......	......	......	......	......	......
25	0.007735	0.2033	2.7186	......	......	......	......	......	......	......	......	......
26	0.005971	0.1611	2.1171	......	......	......	......	......	......	......	......	......
27	0.004575	0.1292	1.8616	......	......	......	......	......	......	......	......	......
28	0.003527	0.0999	1.4734	......	......	......	......	......	......	......	......	......
29	0.002687	0.0818	1.2191	......	......	......	......	......	......	......	......	......
30	0.002065	0.0608	1.0907	......	......	......	......	......	......	......	......	......

TABLE III

THE SECULAR PART OF $a' R_1$ AND $a' a \frac{d R_1}{d a}$

	$a' R_1$	$a' a \frac{d R_1}{d a}$
	+0.0865918	+9.8583567
e^2	+0.0251538	+0.8761220
e'^2	+0.0251538	+0.8761220
η^2	−0.6272122	−1.4781822
$ee' \cos(\pi' - \omega)$	−0.2607341	−1.1557895
e^4	+0.56190	+1.74322
$e^2 e'^2$	+1.33401	+2.47198
e'^4	+0.88484	+1.98512
$e^2 \eta^2$	−1.93599	−3.07405
$e'^2 \eta^2$	−1.93599	−3.07405
η^4	+1.76281	+3.06850
$e^3 e' \cos(\pi' - \omega)$	−1.24424	−2.40640
$ee'^3 \cos(\pi' - \omega)$	−1.40074	−2.52614
$ee' \eta^2 \cos(\pi' - \omega)$	+2.22418	+3.36840

	$a' R_1$	$a\ a \frac{d R_1}{d a}$
$e^2 e'^2 \cos(2\pi' - 2\omega)$	+0.99969	+2.15413
$e^2 \eta^2 \cos(2\omega - 2\tau)$	+1.78790	+2.86277
$ee' \eta^2 \cos(\pi' + \omega - 2\tau')$	−1.92947	−3.06977
$e'^2 \eta^2 \cos(2\pi' - 2\tau')$	+1.46501	+2.64637
e^6	+1.27508	
$e^4 e'^2$	+2.43034	
$e^2 e'^4$	+2.62632	
e'^6	+1.87452	
$e^5 e' \cos(\pi' - \omega)$	−1.15232	
$e^3 e'^3 \cos(\pi' - \omega)$	−2.82749	
$ee'^5 \cos(\pi' - \omega)$	−2.54231	
$e^4 e'^2 \cos(2\pi' - 2\omega)$	+2.24628	
$e^2 e'^4 \cos(2\pi' - 2\omega)$	+2.43887	
$e^3 e'^3 \cos(3\pi' - 3\omega)$	−1.85260	

TABLE IV

THE PERIODIC PART OF R_{01} AND $a' a \frac{d R_{01}}{d a}$

	$a' R_1$	$a\ a \frac{d R_1}{d a}$
$\cos(l' - \lambda)$*	0.00721	+0.28184
$(2l' - 2\lambda)$	9.77533	0.25164
$(3l' - 3\lambda)$	9.58197	0.19025
$(4l' - 4\lambda)$	9.40673	0.11423
$(5l' - 5\lambda)$	9.24211	0.02949
$(6l' - 6\lambda)$	9.08452	9.93889
$(7l' - 7\lambda)$	8.93191	9.84406
$(8l' - 8\lambda)$	8.78305	9.74602
$(9l' - 9\lambda)$	8.63708	9.64544
$(10l' - 10\lambda)$	8.49313	9.54281
$(11l' - 11\lambda)$	8.35170	9.43851
$(12l' - 12\lambda)$	8.21155	9.33277
$(13l' - 13\lambda)$	8.07273	9.22583
$(14l' - 14\lambda)$	7.93510	9.11782
$(15l' - 15\lambda)$	7.79844	9.00893
$(16l' - 16\lambda)$	7.66266	8.89921
$(17l' - 17\lambda)$	7.52763	8.78883
$(18l' - 18\lambda)$	7.39322	8.67781
$(19l' - 19\lambda)$	7.25935	8.56626
$(20l' - 20\lambda)$	7.12613	8.45408
$(21l' - 21\lambda)$	6.99341	8.34177
$(22l' - 22\lambda)$	6.86091	8.20260
$(23l' - 23\lambda)$	6.72916	8.11561
$(24l' - 24\lambda)$	6.59770	8.00286
$(25l' - 25\lambda)$	6.46687	7.88846
$(26l' - 26\lambda)$	6.33646	7.77605
$(27l' - 27\lambda)$	6.20683	7.66039
$(28l' - 28\lambda)$	6.07918	7.51741
$e^2 \cos\ 1(l' - \lambda)$†	+0.11873	+1.12581
2 (")	+8.51634	+0.94394
3 (")	−0.01770	+0.43016
4 (")	−0.25362	−0.56341

	$a' R_1$	$a' a \frac{d R_1}{d a}$
$e^2 \cos\ 5(l' - \lambda)$	−0.35075	−0.97380
6 (")	−0.38904	−1.14951
7 (")	−0.39410	−1.24479
8 (")	−0.37758	−1.29703
9 (")	−0.34586	−1.32173
10 (")	−0.30281	−1.32699
11 (")	−0.25101	−1.31768
12 (")	−0.19218	−1.29697
13 (")	−0.12762	−1.26701
14 (")	−0.05835	−1.22951
15 (")	−9.98498	−1.18546
$e'^2 \cos\ 1(l' - \lambda)$‡	+0.11873	+1.12581
2 (")	+8.51634	+0.94394
3 (")	−0.01770	+0.43016
4 (")	−0.25362	−0.56341
5 (")	−0.35075	−0.97380
6 (")	−0.38904	−1.14951
7 (")	−0.39410	−1.24479
8 (")	−0.37758	−1.29703
9 (")	−0.31586	−1.32173
10 (")	−0.30281	−1.32699
11 (")	−0.25101	−1.31768
12 (")	−0.19218	−1.29697
13 (")	−0.12762	−1.26701
14 (")	−0.05835	−1.22951
15 (")	−9.98498	−1.18546
16 (")	−9.90806	−1.10319
17 (")	−9.82827	−1.08171
18 (")	−9.74554	−1.02395
19 (")	−9.66068	−0.96123
20 (")	−9.57357	−0.89724
21 (")	−9.48515	−0.82730

	$a\ R_{01}$	$a' a \frac{dR_{01}}{da}$		$a\ R_{01}$	$a\ a \frac{dR_{01}}{da}$
* $\cos(l - \lambda)$	9.41901	0.06418	‡ $e'^2 \cos(l' - \lambda)$	0.22828	1.13790
† $e^2 \cos(l - \lambda)$	0.22828	1.13790			

TABLE IV — *Continued*

	$a' R_1$	$a'a \frac{dR_1}{da}$
$e'^2 \cos 22\,(l'-\lambda)$	−9.39375	−0.76103
23 (")	−9.30276	−0.68869
24 (")	−9.20898	−0.61236
25 (")	−9.11528	−0.53135
26 (")	−9.01870	−0.42275
27 (")	−8.92376	−0.36881
$\eta^2 \cos 1\,(l'-\lambda)$*	−0.91949	−1.77208
2 (")	−0.86242	−1.75256
3 (")	−0.78855	−1.72103
4 (")	−0.70515	−1.67940
5 (")	−0.61557	−1 61780
6 (")	−0.52144	−1.57267
7 (")	−0.42405	−1.49467
8 (")	−0.32396	−1.44270
9 (")	−0.22089	−1.37112
10 (")	−0.11780	−1.29593
11 (")	−0 01235	−1.19052
12 (")	−9.90566	−1.13657
13 (")	−9.7941	....
14 (")	−9.6874	....
$ee' \cos(-14l'+14\lambda-\pi'+\omega)$	+9.96354	+1.16320
$(-13l'+13\lambda-\pi'+\omega)$	+0.03481	+1.20534
$(-12l'+12\lambda-\pi'+\omega)$	+0.10201	+1.24054
$(-11l'+11\lambda-\pi'+\omega)$	+0.16646	+1.26770
$(-10l'+10\lambda-\pi'+\omega)$	+0.21979	+1.28490
$(-\ 9l'+\ 9\lambda-\pi'+\omega)$	+0.26775	+1.28974
$(-\ 8l'+\ 8\lambda-\pi'+\omega)$	+0.30586	+1.27846
$(-\ 7l'+\ 7\lambda-\pi'+\omega)$	+0.33099	+1.24521
$(-\ 6l'+\ 6\lambda-\pi'+\omega)$	+0.35423	+1.19935
$(-\ 5l'+\ 5\lambda-\pi'+\omega)$	+0.31908	+1.06082
$(-\ 4l'+\ 4\lambda-\pi'+\omega)$	+0.25649	+0.82859
$(-\ 3l'+\ 3\lambda-\pi'+\omega)$	+0.10825	+0.02437
$(-\ 2l'+\ 2\lambda-\pi'+\omega)$	+9.67090	−0.70045
$(-\ 1l'+\ 1\lambda-\pi'+\omega)$	−9.79862	−1.02424
$(+\ 1l'-\ 1\lambda-\pi'+\omega)$	−0.32618	−1.17715
$(+\ 2l'-\ 2\lambda-\pi'+\omega)$†	−9.90635	−1.09348
$(+\ 3l'-\ 3\lambda-\pi'+\omega)$	+9.75072	−0.84535
$(+\ 4l'-\ 4\lambda-\pi'+\omega)$	+0.20803	−9.56584
$(+\ 5l'-\ 5\lambda-\pi'+\omega)$	+0.36239	+0.79665
$(+\ 6l'-\ 6\lambda-\pi'+\omega)$	+0.42800	+1.08243
$(+\ 7l'-\ 7\lambda-\pi'+\omega)$	+0.44929	+1.22312
$(+\ 8l'-\ 8\lambda-\pi'+\omega)$	+0.44361	+1.30135
$(+\ 9l'-\ 9\lambda-\pi'+\omega)$	+0.41967	+1.34332
$(+10l'-10\lambda-\pi'+\omega)$	+0.38249	+1.36107
$(+11l'-11\lambda-\pi'+\omega)$	+0.33524	+1.36129
$(+12l'-12\lambda-\pi'+\omega)$	+0.28013	+1.34813
$(+13l'-13\lambda-\pi'+\omega)$	+0.21862	+1.32438
$(+14l'-14\lambda-\pi'+\omega)$	+0.15180	+1.29195
$(+15l'-15\lambda-\pi'+\omega)$	+0.08066	+1.25240
$(+16l'-16\lambda-\pi'+\omega)$	+0.00568	+1.20663
$(+17l'-17\lambda-\pi'+\omega)$	+9.92612	+1.15582
$(+18l'-18\lambda-\pi'+\omega)$	+9.84639	+1.10013
$(+19l'-19\lambda-\pi'+\omega)$	+9.76262	+1.04123
$(+20l'-20\lambda-\pi'+\omega)$	+9.67678	+0.97754
$e \cos(-21l'+22\lambda-\omega)$	+8.00000	+9.33183
$(-20l'+21\lambda-\omega)$	+8.07918	+9.41963
$(-19l'+20\lambda-\omega)$	+8.20412	+9.50799
$(-18l'+19\lambda-\omega)$	+8.31597	+9.59306
$(-17l'+18\lambda-\omega)$	+8.42325	+9.67688
$(-16l'+17\lambda-\omega)$	+8.53020	+9.75747

	$a' R_1$	$a'a \frac{dR_1}{da}$
$e \cos(-15l'+16\lambda-\omega)$	+8.63615	+9.83573
$(-14l'+15\lambda-\omega)$	+8.70024	+9.91034
$(-13l'+14\lambda-\omega)$	+8.84260	+9.98124
$(-12l'+13\lambda-\omega)$	+8.94315	+0.04738
$(-11l'+12\lambda-\omega)$	+8.99994	+0.10800
$(-10l'+11\lambda-\omega)$	+9.13667	+0.16173
$(-\ 9l'+10\lambda-\omega)$	+9.22846	+0.20683
$(-\ 8l'+\ 9\lambda-\omega)$	+9.31558	+0.24062
$(-\ 7l'+\ 8\lambda-\omega)$	+9.39664	+0.25901
$(-\ 6l'+\ 7\lambda-\omega)$	+9.46912	+0.25498
$(-\ 5l'+\ 6\lambda-\omega)$	+9.52892	+0.21495
$(-\ 4l'+\ 5\lambda-\omega)$	+9.56825	+0.10616
$(-\ 3l'+\ 4\lambda-\omega)$	+9.56925	+9.80115
$(-\ 2l'+\ 3\lambda-\omega)$	+9.47673	−9.57062
$(-\ 1l'+\ 2\lambda-\omega)$‡	+8.77790	−0.25333
$(\ \ 0\ +\ 1\lambda-\omega)$	−9.85836	−0.54615
$(+\ 1l'+\ 0\ -\omega)$‖	−0.29524	−0.74966
$(+\ 2l'-\ 1\lambda-\omega)$	−0.31905	−0.87577
$(+\ 3l'-\ 2\lambda-\omega)$	−0.28341	−0.93780
$(+\ 4l'-\ 3\lambda-\omega)$	−0.22294	−0.96047
$(+\ 5l'-\ 4\lambda-\omega)$	−0.14868	−0.95724
$(+\ 6l'-\ 5\lambda-\omega)$	−0.06568	−0.93582
$(+\ 7l'-\ 6\lambda-\omega)$	−9.97662	−0.90097
$(+\ 8l'-\ 7\lambda-\omega)$	−9.88312	−0.85582
$(+\ 9l'-\ 8\lambda-\omega)$	−9.78621	−0.80252
$(+10l'-\ 9\lambda-\omega)$	−9.68661	−0.74262
$(+11l'-10\lambda-\omega)$	−9.58485	−0.67725
$(+12l'-11\lambda-\omega)$	−9.48128	−0.60731
$(+13l'-12\lambda-\omega)$	−9.37621	−0.53345
$(+14l'-13\lambda-\omega)$	−9.26987	−0.45625
$(+15l'-14\lambda-\omega)$	−9.16240	−0.37608
$(+16l'-15\lambda-\omega)$	−9.05346	−0.29336
$(+17l'-16\lambda-\omega)$	−8.94448	−0.20832
$(+18l'-17\lambda-\omega)$	−8.8325	−0.12140
$(+19l'-18\lambda-\omega)$	−8.7193	−0.03041
$(+20l'-19\lambda-\omega)$	−8.6128	−9.98909
$(+21l'-20\lambda-\omega)$	−8.4914	−9.84991
$(+22l'-21\lambda-\omega)$	−8.3802	−9.71742
$(+23l'-22\lambda-\omega)$	−8.2787	−9.66238
$(+24l'-23\lambda-\omega)$	−8.1461	−9.59450
$(+25l'-24\lambda-\omega)$	−8.0414	−9.46982
$(+26l'-25\lambda-\omega)$	−7.9294	−9.36254
$(+27l'-26\lambda-\omega)$	−7.7781	−9.27439
$e'\eta^2 \cos(-\ 5l'+\ 6\lambda-\pi')$	−9.5670	−1.64789
$(-\ 4l'+\ 5\lambda-\pi')$	−0.3363	−1.86721
$(-\ 3l'+\ 4\lambda-\pi')$	−0.78866	−2.07463
$(-\ 2l'+\ 3\lambda-\pi')$	−1.03902	−2.22685
$(-\ 1l'+\ 2\lambda-\pi')$	−1.23930	−2.34916
$(\quad 1\lambda-\pi')$	−1.40534	−2.45372
$(+\ 1l'\quad -\pi')$	−1.53534	−2.53806
$(+\ 2l'-\ 1\lambda-\pi')$§	−1.62371	−2.60488
$(+\ 3l'-\ 2\lambda-\pi')$	−1 66741	−2.65296
$(+\ 4l'-\ 3\lambda-\pi')$	−1.67953	−2.68395
$(+\ 5l'-\ 4\lambda-\pi')$	−1.66951	−2.70998
$(+\ 6l'-\ 5\lambda-\pi')$	−1.63782	−2.69873
$(+\ 7l'-\ 6\lambda-\pi')$	−1.60461	−2.69293
$(+\ 8l'-\ 7\lambda-\pi')$	−1.55060	−2.67025
$(+\ 9l'-\ 8\lambda-\pi')$	−1.50213	−2.64392
$(+10l'-\ 9\lambda-\pi')$	−1.44059	−2.61200
$(+11l'-10\lambda-\pi')$	−1 37392	−2.56806
$(+12l'-11\lambda-\pi')$	−1.30085	−2.52496

	$a' R_{01}$	$a'a \frac{dR_{01}}{da}$
* $\eta^2 \cos(l-\lambda)$	−0.87815	−1.76651
† $ee' \cos(2l-2\lambda-\pi'+\omega)$	−0.19321	−1.11913
‡ $e \cos(-1l+2\lambda-\omega)$	−9.50312	−0.33627
‖ $e \cos(+1l-\omega)$	−9.92532	−0.82933
§ $e'\eta^2 \cos(2l-\lambda-\pi)$	−1.60785	−2.60325

TABLE IV—*Continued*

	$a'R_1$	$a'a\frac{dR_1}{da}$
$e^2e'\cos(-5l'+4\lambda-\pi'+2\omega)$	−0.8880	−1.56745
$(-4l'+3\lambda-\pi'+2\omega)$	−0.69906	−0.96806
$(-3l'+2\lambda-\pi'+2\omega)$	−0.30291	+1.14196
$(-2l'+1\lambda-\pi'+2\omega)$	+9.92231	+1.63487
$(-1l\quad-\pi'+2\omega)$	+0.44722	+1.57314
$(\quad-1\lambda-\pi'+2\omega)$	+0.50232	+1.54949
$(+1l'-2\lambda-\pi'+2\omega)$	+0.33640	+1.44892
$(+2l'-3\lambda-\pi'+2\omega)$*	+0.25082	+1.31174
$(+3l'-4\lambda-\pi'+2\omega)$	+0.33062	+1.20852
$(+4l'-5\lambda-\pi'+2\omega)$	+0.46735	+1.20702
$(+5l'-6\lambda-\pi'+2\omega)$	+0.59298	+1.30750
$(+6l'-7\lambda-\pi'+2\omega)$	+0.67669	+1.43470
$(+7l'-8\lambda-\pi'+2\omega)$	+0.73775	+1.55163
$(+8l'-9\lambda-\pi'+2\omega)$	+0.77320	+1.64573
$(+9l'-10\lambda-\pi'+2\omega)$	+0.79085	....
$ee'^2\cos(-3l'+4\lambda-2\pi'+\omega)$	−0.27967	−1.85450
$(-2l'+3\lambda-2\pi'+\omega)$	−0.27183	−1.33136
$(-1l'+2\lambda-2\pi'+\omega)$	−0.34415	−1.43722
$(\quad+\lambda-2\pi'+\omega)$	−0.49862	−1.60499
$(+1l'\quad-2\pi'+\omega)$†	−0.67435	−1.66780
$(+2l'-\lambda-2\pi'+\omega)$	−0.76926	−1.73583
$(+3l'-2\lambda-2\pi'+\omega)$‡	−0.63517	−1.74196
$(+4l'-3\lambda-2\pi'+\omega)$	−9.84466	−1.64784
$(+5l'-4\lambda-2\pi'+\omega)$	+0.58035	−1.33764
$(+6l'-5\lambda-2\pi'+\omega)$	+0.92130	+1.00639
$(+7l'-6\lambda-2\pi'+\omega)$	+1.08595	+1.67554
$(+8l'-7\lambda-2\pi'+\omega)$	+1.18222	+1.93308
$(+9l'-8\lambda-2\pi'+\omega)$	+1.23636	+2.08651
$(+10l'-9\lambda-2\pi'+\omega)$	+1.26588	+2.18250
$(+11l'-10\lambda-2\pi'+\omega)$	+1.27442	+2.25244
$(+12l'-11\lambda-2\pi'+\omega)$	+1.30750	+2.29465
$(+13l'-12\lambda-2\pi'+\omega)$	+1.2923	+2.3124
$(+14l'-13\lambda-2\pi'+\omega)$	+1.2624	+2.3302
$(+15l'-14\lambda-2\pi'+\omega)$	+1.2253	+2.3248
$(+16l'-15\lambda-2\pi'+\omega)$	+1.1861	+2.3193
$(+17l'-16\lambda-2\pi'+\omega)$	+1.1400	+2.2944
$(+18l'-17\lambda-2\pi'+\omega)$	+1.0864	+2.2695
$(+19l'-18\lambda-2\pi'+\omega)$	+1.0294	......
$(+20l'-19\lambda-2\pi'+\omega)$	+0.9689	......
$e\eta^2\cos(-7l'+8\lambda+\omega-2\tau')$	−1.2074	−2.38643
$(-6l'+7\lambda+\omega-2\tau')$	−1.2652	−2.40115
$(-5l'+6\lambda+\omega-2\tau')$	−1.3038	−2.42015
$(-4l'+5\lambda+\omega-2\tau')$	−1.3579	−2.42130
$(-3l'+4\lambda+\omega-2\tau')$	−1.3890	−2.40954
$(-2l'+3\lambda+\omega-2\tau')$	−1.4053	−2.38263
$(-1l'+2\lambda+\omega-2\tau')$	−1.40226	−2.33788
$(\quad+1\lambda+\omega-2\tau')$	−1.37107	−2.27635
$(+1l'\quad+\omega-2\tau')$‖	−1.29957	−2.19749
$(+2l'-1\lambda+\omega-2\tau')$	−1.17705	−2.10319
$(+3l'-2\lambda+\omega-2\tau')$	−1.02811	−1.99008
$(+4l'-3\lambda+\omega-2\tau')$	−0.85473	−1.68111
$(+5l'-4\lambda+\omega-2\tau')$	−0.6522	−1.45964
$e'\eta^2\cos(-12l'+13\lambda+\pi'-2\tau')$	+0.8957	+2.14747
$(-11l'+12\lambda+\pi'-2\tau')$	+0.9694	+2.19770
$(-10l'+11\lambda+\pi'-2\tau')$	+1.03910	+2.24296
$(-9l'+10\lambda+\pi'-2\tau')$	+1.10898	+2.27639
$(-8l'+9\lambda+\pi'-2\tau')$	+1.16382	+2.31562
$(-7l'+8\lambda+\pi'-2\tau')$	+1.21675	+2.34110
$(-6l'+7\lambda+\pi'-2\tau')$	+1.24785	+2.35007

	$a'R_1$	$a'a\frac{dR_1}{da}$
$e'\eta^2\cos(-5l'+6\lambda+\pi'-2\tau')$	+1.29596	+2.40281
$(-4l'+5\lambda+\pi'-2\tau')$	+1.31680	+2.35763
$(-3l'+4\lambda+\pi'-2\tau')$	+1.31943	+2.33646
$(-2l'+3\lambda+\pi'-2\tau')$	+1.29627	+2.29751
$(-l'+2\lambda+\pi'-2\tau')$	+1.23431	+2.23702
$(\quad+\lambda+\pi'-2\tau')$	+1.11194	+2.15580
$(+l'\quad+\pi'-2\tau')$	+0.93827	+2.05097
$(+2l'-\lambda+\pi'-2\tau')$	+0.71600	+1.92361
$(+3l'-2\lambda+\pi'-2\tau')$	+0.41280	+1.76335
$(+4l'-3\lambda+\pi'-2\tau')$	+9.869	+1.49128
$(+5l'-4\lambda+\pi'-2\tau')$	+9.695	+0.50284
$e^2\cos(-15l'+17\lambda-2\omega)$	+9.24027	+0.43503
$(-14l'+16\lambda-2\omega)$	+9.31742	+0.48170
$(-13l'+15\lambda-2\omega)$	+9.39085	+0.52397
$(-12l'+14\lambda-2\omega)$	+9.46082	+0.55912
$(-11l'+13\lambda-2\omega)$	+9.52625	+0.58718
$(-10l'+12\lambda-2\omega)$	+9.58652	+0.60623
$(-9l'+11\lambda-2\omega)$	+9.64061	+0.61491
$(-8l'+10\lambda-2\omega)$	+9.68729	+0.61095
$(-7l'+9\lambda-2\omega)$	+9.72481	+0.59171
$(-6l'+8\lambda-2\omega)$	+9.75101	+0.55413
$(-5l'+7\lambda-2\omega)$	+9.76288	+0.49529
$(-4l'+6\lambda-2\omega)$	+9.75645	+0.41556
$(-3l'+5\lambda-2\omega)$	+9.72682	+0.32907
$(-2l'+4\lambda-2\omega)$	+9.67070	+0.28771
$(-1l'+3\lambda-2\omega)$§†	+9.59754	+0.37614
$(\quad+2\lambda-2\omega)$	+9.52883	+0.60222
$(+1l'+\lambda-2\omega)$*†	+0.01641	+0.86905
$(+2l'\quad-2\omega)$	+0.40522	+1.12207
$(+3l'-\lambda-2\omega)$	+0.57404	+1.31007
$(+4l'-2\lambda-2\omega)$	+0.65307	+1.43951
$(+5l'-3\lambda-2\omega)$	+0.68475	+1.52567
$(+6l-4\lambda-2\omega)$	+0.68708	+1.58014
$(+7l'-5\lambda-2\omega)$	+0.66940	+1.61081
$(+8l'-6\lambda-2\omega)$	+0.63725	+1.62313
$(+9l'-7\lambda-2\omega)$	+0.59411	+1.62091
$(+10l'-8\lambda-2\omega)$	+0.54238	+1.60692
$(+11l'-9\lambda-2\omega)$	+0.48375	+1.58323
$(+12l'-10\lambda-2\omega)$	+0.41942	+1.57516
$(+13l'-11\lambda-2\omega)$	+0.35033	+1.51267
$(+14l'-12\lambda-2\omega)$	+0.27722	+1.46801
$(+15l'-13\lambda-2\omega)$	+0.20117	+1.41817
$e^4\cos(6l'-4\lambda-2\omega)$	−1.12189	....
$e^2e'^2\cos(6l'-4\lambda-2\omega)$	−1.96412	....
$e^2\eta^2\cos(6l'-4\lambda-2\omega)$	−2.37355	....
$ee'\cos(-14l'+16\lambda-\pi'+\omega)$	−9.45461	−0.66219
$(-13l'+15\lambda-\pi'+\omega)$	−9.52409	−0.68980
$(-12l'+14\lambda-\pi'+\omega)$	−9.59232	−0.72546
$(-11l'+13\lambda-\pi'+\omega)$	−9.65343	−0.75293
$(-10l'+12\lambda-\pi'+\omega)$	−9.71070	−0.77237
$(-9l'+11\lambda-\pi'+\omega)$	−9.76026	−0.78155
$(-8l'+10\lambda-\pi'+\omega)$	−9.80168	−0.77921
$(-7l'+9\lambda-\pi'+\omega)$	−9.83322	−0.76337
$(-6l'+8\lambda-\pi'+\omega)$	−9.85272	−0.73261
$(-5l'+7\lambda-\pi'+\omega)$	−9.85763	−0.68749
$(-4l'+6\lambda-\pi'+\omega)$	−9.84562	−0.63481
$(-3l'+5\lambda-\pi'+\omega)$	−9.81730	−0.60033

	$a'R_{01}$	$a'a\frac{dR_{01}}{da}$		$a\,R_{01}$	$a'a\frac{dR_{01}}{da}$
* $e^2e'\cos(2l'-3\lambda-\pi'+2\omega)$	+0.08489	+1.29959	‖ $e\eta^2\cos(l+\omega-2\tau')$	−1.27419	−2.19436
† $ee'^2\cos(l-2\pi+\omega)$	−0.66115	+1.66348	§† $e^2\cos(-l'+3\lambda-2\omega)$	+9.05308	+0.32112
‡ $ee'^2\cos(3l-2\lambda-2\pi'+\omega)$	−0.74740	−1 75186	*† $e^2\cos(-l+\lambda-2\omega)$	+9 97509	+0 68348

TABLE IV—*Continued*

	$a'R_1$	$a'a\frac{dR_1}{da}$
$ee'\cos(-2l'+4\lambda-\pi'+\omega)$	-9.78599	-0.61951
$(-1l'+3\lambda-\pi'+\omega)$	-9.80319	-0.74161
$(+2\lambda-\pi'+\omega)$	-9.96440	-0.94535
$(+1l'+1\lambda-\pi'+\omega)$*	-0.32618	-1.17716
$(+2l'-\pi'+\omega)$	-0.76116	-1.40475
$(+3l'-1\lambda-\pi'+\omega)$	-0.95270	-1.60877
$(+4l'-2\lambda-\pi'+\omega)$	-1.04356	-1.75595
$(+5l'-3\lambda-\pi'+\omega)$	-1.08220	-1.85722
$(+6l'-4\lambda-\pi'+\omega)$	-1.08907	-1.92368
$(+7l'-5\lambda-\pi'+\omega)$	-1.07461	-1.96385
$(+8l'-6\lambda-\pi'+\omega)$	-1.04473	-1.98376
$(+9l'-7\lambda-\pi'+\omega)$	-1.00354	-1.98771
$(+10l'-8\lambda-\pi'+\omega)$	-0.95327	-1.97885
$(+11l'-9\lambda-\pi'+\omega)$	-0.89581	-1.95945
$(+12l'-10\lambda-\pi'+\omega)$	-0.83247	-1.93127
$(+13l'-11\lambda-\pi'+\omega)$	-0.76422	-1.89567
$(+14l'-12\lambda-\pi'+\omega)$	-0.69179	-1.84138
$(+15l'-13\lambda-\pi'+\omega)$	-0.61583	-1.80627
$(+16l'-14\lambda-\pi'+\omega)$	-0.53674	-1.75403
$(+17l'-15\lambda-\pi'+\omega)$	-0.45500	....
$(+18l'-16\lambda-\pi'+\omega)$	-0.37162	....
$(+19l'-17\lambda-\pi'+\omega)$	-0.28443	....
$(+20l'-18\lambda-\pi'+\omega)$	-0.19590	....
$(+21l'-19\lambda-\pi'+\omega)$	-0.10619	....
$(+22l'-20\lambda-\pi'+\omega)$	-0.01410	....
$(+23l'-21\lambda-\pi'+\omega)$	-9.92169	....
$(+24l'-22\lambda-\pi'+\omega)$	-9.82802	....
$(+25l'-23\lambda-\pi'+\omega)$	-9.73320	....
$e^3e'\cos(6l'-4\lambda-\pi'-\omega)$	$+1.55169$	
$ee'^3\cos(6l'-4\lambda-\pi'+\omega)$	$+1.90298$	
$ee'\eta^2\cos(6l'-4\lambda-\pi'-\omega)$	$+2.67076$	
$e'^2\cos(-13l'+15\lambda-2\pi')$	$+9.05721$	$+0.25209$
$(-12l'+14\lambda-2\pi')$	$+9.12087$	$+0.28538$
$(-11l'+13\lambda-2\pi')$	$+9.17921$	$+0.31322$
$(-10l'+12\lambda-2\pi')$	$+9.23160$	$+0.33160$
$(-9l'+11\lambda-2\pi')$	$+9.27674$	$+0.34096$
$(-8l'+10\lambda-2\pi')$	$+9.31260$	$+0.33905$
$(-7l'+9\lambda-2\pi')$	$+9.33832$	$+0.32542$
$(-6l'+8\lambda-2\pi')$	$+9.35170$	$+0.29997$
$(-5l+7\lambda-2\pi')$	$+9.35120$	$+0.26624$
$(-4l'+6\lambda-2\pi')$	$+9.33760$	$+0.23602$
$(-3l'+5\lambda-2\pi')$	$+9.31988$	$+0.23562$
$(-2l'+4\lambda-2\pi')$	$+9.32919$	$+0.30124$
$(-1l'+3\lambda-2\pi')$	$+0.42933$	$+0.44797$
$(+2\lambda-2\pi')$	$+0.66761$	$+0.65018$
$(+1l'+1\lambda-2\pi')$†	$+0.01535$	$+0.86905$
$(+2l'-2\pi')$	$+0.47741$	$+1.07029$
$(+3l'-1\lambda-2\pi')$‡	$+0.71910$	$+1.28134$
$(+4l'-2\lambda-2\pi')$	$+0.82723$	$+1.45132$
$(+5l'-3\lambda-2\pi')$	$+0.87482$	$+1.57246$
$(+6l'-4\lambda-2\pi')$	$+0.88721$	$+1.65437$
$(+7l'-5\lambda-2\pi')$	$+0.87649$	$+1.70646$
$(+8l'-6\lambda-2\pi')$	$+0.84943$	$+1.73492$
$(+9l'-7\lambda-2\pi')$	$+0.81018$	$+1.74713$
$(+10l'-8\lambda-2\pi')$	$+0.76153$	$+1.74431$
$(+11l'-9\lambda-2\pi')$	$+0.70536$	$+1.72992$
$(+12l'-10\lambda-2\pi')$	$+0.64307$	$+1.70594$

	$a'R_1$	$a'a\frac{dR_1}{da}$
$e'^2\cos(+13l'-11\lambda-2\pi')$	$+0.56873$	$+1.67392$
$(+14l'-12\lambda-2\pi')$	$+0.50405$	$+1.63504$
$(+15l'-13\lambda-2\pi')$	$+0.42870$	$+1.59026$
$(+16l'-14\lambda-2\pi')$	$+0.32885$	$+1.54035$
$(+17l'-15\lambda-2\pi')$	$+0.26891$	$+1.48593$
$(+18l'-16\lambda-2\pi')$	$+0.18518$	....
$(+19l'-17\lambda-2\pi')$	$+0.09914$	....
$(+20l'-18\lambda-2\pi')$	$+0.01641$	....
$(+21l'-19\lambda-2\pi')$	$+9.92174$	....
$(+22l'-20\lambda-2\pi')$	$+9.828$	....
$(+23l'-21\lambda-2\pi')$	$+9.736$	....
$(+24l'-22\lambda-2\pi')$	$+9.642$	....
$(+25l'-23\lambda-2\pi')$	$+9.549$	....
$e^2e'^2\cos(6l'-4\lambda-2\pi')$	-1.43088	
$e'^4\cos(6l'-4\lambda-2\pi')$	-1.38917	
$e'^2\eta^2\cos(6l'-4\lambda-2\pi')$	-2.41885	
$ee'^3\cos(6l'-4\lambda-2\pi')$	$+0.61278$	
$\eta^2\cos(-9l'+11\lambda-2\tau')$	$+9.80482$	$+0.98963$
$(-8l'+10\lambda-2\tau')$	$+9.90875$	$+1.06556$
$(-7l'+9\lambda-2\tau')$	$+0.01207$	$+1.13965$
$(-6l'+8\lambda-2\tau')$	$+0.11295$	$+1.20649$
$(-5l'+7\lambda-2\tau')$	$+0.21128$	$+1.26022$
$(-4l'+6\lambda-2\tau')$	$+0.30652$	$+1.32837$
$(-3l'+5\lambda-2\tau')$	$+0.39791$	$+1.37988$
$(-2l'+4\lambda-2\tau')$	$+0.48377$	$+1.42334$
$(-1l'+3\lambda-2\tau')$	$+0.56176$	$+1.45683$
$(+2\lambda-2\tau')$	$+0.62721$	$+1.47818$
$(+1l'+1\lambda-2\tau')$‖	$+0.66859$	$+1.48493$
$(+2l'-2\tau')$	$+0.62721$	$+1.47818$
$(+3l'-1\lambda-2\tau')$	$+0.56176$	$+1.45683$
$(+4l'-2\lambda-2\tau')$	$+0.48377$	$+1.42331$
$(+5l'-3\lambda-2\tau')$	$+0.39791$	$+1.37988$
$(+6l'-4\lambda-2\tau')$	$+0.30652$	$+1.32837$
$(+7l'-5\lambda-2\tau')$	$+0.21128$	$+1.26022$
$(+8l'-6\lambda-2\tau')$	$+0.11295$	$+1.20649$
$(+9l'-7\lambda-2\tau')$	$+0.01207$	$+1.13965$
$(+10l'-8\lambda-2\tau')$	$+9.90875$	$+1.06556$
$(+11l'-9\lambda-2\tau')$	$+9.80482$	$+0.98963$
$e^2\eta^2\cos(6l'-4\lambda-2\tau')$	$+1.60097$	
$e'^2\eta^2\cos(6l'-4\lambda-2\tau')$	-9.77815	
$\eta^4\cos(6l'-4\lambda-2\tau')$	-1.8902	
$e^3\cos(-4l'+7\lambda-3\omega)$	$+9.8553$	$+0.40115$
$(-3l'+6\lambda-3\omega)$	$+9.7528$	$+9.98511$
$(-2l'+5\lambda-3\omega)$	$+9.5688$	-9.72835
$(-1l'+4\lambda-3\omega)$§	$+8.91434$	-0.36710
$(+3\lambda-3\omega)$	-9.47553	-0.65861
$(+1l'+2\lambda-3\omega)$*†	-9.76373	-0.91747
$(+2l'+1\lambda-3\omega)$	-0.19564	-1.19371
$(+3l'-3\omega)$	-0.57471	-1.45904
$(+4l'-1\lambda-3\omega)$	-0.81489	-1.68553
$(+5l'-2\lambda-3\omega)$	-0.96891	-1.86215
$(+6l'-3\lambda-3\omega)$	-1.06843	-1.99642
$(+7l'-4\lambda-3\omega)$	-1.13096	-2.09720

	$a\,R_{01}$	$a'a\frac{dR_{01}}{da}$
* $ee\cos(l'+\lambda-\pi'+\omega)$	-0.54492	-1.36718
† $e'^2\cos(l'+\lambda-2\pi')$	$+0.22818$	$+0.86347$
‡ $e'^2\cos(3l'-\lambda-2\pi')$	$+0.43000$	$+1.21926$
‖ $\eta^2\cos(l'+\lambda-2\tau)$	$+0.59194$	$+1.47407$
§ $e^3\cos(-l'+4\lambda-3\omega)$	-9.22874	-0.41163
*† $e^3\cos(l+2\lambda-3\omega)$	-9.78663	-0.91912

TABLE IV — *Continued*

	$a'R_1$	$a'a\frac{dR_1}{da}$
$e^3\cos(+8l'-5\lambda-3\omega)$	-1.16689	-2.15963
$(+9l'-6\lambda-3\omega)$	-1.22853	-2.22382
$(+10l'-7\lambda-3\omega)$	-1.18324	-2.25182
$(+11l'-8\lambda-3\omega)$	-1.16615	-2.27985
$(+12l'-9\lambda-3\omega)$	-1.14907	....
$e^3\cos(-9l'+10\lambda-\omega)$	-0.74554	....
$(-8l'+9\lambda-\omega)$	-0.73687	....
$(-7l'+8\lambda-\omega)$	-0.71240	-1.58587
$(-6l'+7\lambda-\omega)$	-0.66521	-1.48655
$(-5l'+6\lambda-\omega)$	-0.59757	-1.36900
$(-4l'+5\lambda-\omega)$	-0.49870	-1.25081
$(-3l'+4\lambda-\omega)$	-0.37293	-1.19089
$(-2l'+3\lambda-\omega)$	-0.25876	-1.23550
$(-1l'+2\lambda-\omega)^*$	-0.25551	-1.36203
$(0+1\lambda-\omega)$	-0.41652	-1.49739
$(+1l'\ 0-\omega)$	-0.55374	-1.58743
$(+2l'-1\lambda-\omega)$	-0.46545	-1.60121
$(+3l'-2\lambda-\omega)$	-9.84061	-1.49760
$(+4l'-3\lambda-\omega)$	$+0.36700$	-1.13464
$(+5l'-4\lambda-\omega)$	$+0.73745$	$+1.04552$
$(+6l'-5\lambda-\omega)$	$+0.91761$	$+1.24087$
$(+7l'-6\lambda-\omega)$	$+1.01983$	$+1.84233$
$(+8l'-7\lambda-\omega)$	$+1.08200$	....
$(+9l'-8\lambda-\omega)$	$+1.11383$	....
$(+10l'-9\lambda-\omega)$	$+1.17909$	....
$(+11l'-10\lambda-\omega)$	$+1.17387$	....
$(+12l'-11\lambda-\omega)$	$+1.15698$	....
$ee'^2\cos(-9l'+10\lambda-\omega)$	-0.97630	-1.95796
$(-8l'+9\lambda-\omega)$	-0.96265	-1.89546
$(-7l'+8\lambda-\omega)$	-0.92609	-1.82367
$(-6l'+7\lambda-\omega)$	-0.88947	-1.73521
$(-5l'+6\lambda-\omega)$	-0.81325	-1.64523
$(-4l'+5\lambda-\omega)$	-0.72779	-1.58470
$(-3l'+4\lambda-\omega)$	-0.65040	-1.59260
$(-2l'+3\lambda-\omega)$	-0.63759	-1.67586
$(-1l'+2\lambda-\omega)^\dagger$	-0.72955	-1.79520
$(1\lambda-\omega)$	-0.87612	-1.89643
$(+1l'-\omega)^\ddagger$	-0.90274	-1.94869
$(+2l'-1\lambda-\omega)$	-0.61935	-1.91679
$(+3l'-2\lambda-\omega)$	$+0.25003$	-1.74228
$(+4l'-3\lambda-\omega)$	$+0.95436$	-0.96182
$(+5l'-4\lambda-\omega)$	$+1.20194$	$+1.65287$
$(+6l'-5\lambda-\omega)$	$+1.33746$	$+2.06060$
$(+7l'-6\lambda-\omega)$	$+1.41716$	$+2.25373$
$(+8l'-7\lambda-\omega)$	$+1.46228$	$+2.37566$
$(+9l'-8\lambda-\omega)$	$+1.48328$	$+2.45773$
$(+10l'-9\lambda-\omega)$	$+1.48712$	$+2.51095$
$(+11l'-10\lambda-\omega)$	$+1.47712$	$+2.54469$
$(+12l'-11\lambda-\omega)$	$+1.447$	$+2.56194$
$(+13l'-12\lambda-\omega)$	$+1.416$	$+2.56738$
$(+14l'-13\lambda-\omega)$	$+1.382$	$+2.56573$
$(+15l'-14\lambda-\omega)$	$+1.347$	$+2.5315$
$(+16l'-15\lambda-\omega)$	$+1.307$	....
$(+17l'-16\lambda-\omega)$	$+1.253$	....
$(+18l'-17\lambda-\omega)$	$+1.190$	....
$(+19l'-18\lambda-\omega)$	$+1.113$	....
$e\eta^2\cos(-5l'+6\lambda-\omega)$	$+9.02531$	$+1.71851$
$(-4l'+5\lambda-\omega)$	$+0.55755$	$+1.97703$
$(-3l'+4\lambda-\omega)$	$+0.89581$	$+2.15084$
$(-2l'+3\lambda-\omega)$	$+1.13714$	$+2.29038$

	$a'R_1$	$a'a\frac{dR_1}{da}$
$e\eta^2\cos(-1l'+2\lambda-\omega)\Vert$	$+1.32789$	$+2.40601$
$(+1\lambda-\omega)$	$+1.47807$	$+2.49862$
$(+1l'-\omega)\S$	$+1.57859$	$+2.57175$
$(+2l'-1\lambda-\omega)$	$+1.66789$	$+2.62475$
$(+3l'-2\lambda-\omega)$	$+1.64068$	$+2.66011$
$(+4l'-3\lambda-\omega)$	$+1.64527$	$+2.67877$
$(+5l'-4\lambda-\omega)$	$+1.61669$	$+2.67981$
$(+6l'-5\lambda-\omega)$	$+1.58686$	$+2.67615$
$(+7l'-6\lambda-\omega)$	$+1.53107$	$+2.65498$
$(+8l'-7\lambda-\omega)$	$+1.48746$	$+2.63004$
$(+9l'-8\lambda-\omega)$	$+1{\cdot}42730$	$+2.59940$
$(+10l'-9\lambda-\omega)$	$+1.36171$	$+2.55630$
$(+11l'-10\lambda-\omega)$	$+1.29159$	$+2.51412$
$(+12l'-11\lambda-\omega)$	$+1.21759$	$+2.46377$
$e'\cos(-20l'+21\lambda-\pi')$	-7.954	-9.3090
$(-19l'+20\lambda-\pi')$	-8.0792	-9.3955
$(-18l'+19\lambda-\pi')$	-8.1760	-9.4824
$(-17l'+18\lambda-\pi')$	-8.2900	-9.5658
$(-16l'+17\lambda-\pi')$	-8.3979	-9.6478
$(-15l'+16\lambda-\pi')$	-8.4983	-9.7262
$(-14l'+15\lambda-\pi')$	-8.60338	-9.8021
$(-13l'+14\lambda-\pi')$	-8.70483	-9.7387
$(-12l'+13\lambda-\pi')$	-8.80405	-9.9413
$(-11l'+12\lambda-\pi')$	-8.90087	-0.0034
$(-10l'+11\lambda-\pi')$	-8.99677	-0.0588
$(-9l'+10\lambda-\pi')$	-9.08426	-0.1061
$(-8l'+9\lambda-\pi')$	-9.16892	-0.1427
$(-7l'+8\lambda-\pi')$	-9.24673	-0.16485
$(-6l'+7\lambda-\pi')$	-9.31486	-0.16624
$(-5l'+6\lambda-\pi')$	-9.36881	-0.13494
$(-4l'+5\lambda-\pi')$	-9.39914	-0.04347
$(-3l'+4\lambda-\pi')$	-9.38463	-9.79691
$(-2l'+3\lambda-\pi')$	-9.25513	$+9.15297$
$(-1l'+2\lambda-\pi')$	-7.22194	$+0.10195$
$(+1\lambda-\pi')$	$+9.65167$	$+0.43914$
$(+1l'-\pi')$	$+0.28833$	$+0.62721$
$(+2l'-1\lambda-\pi')^{*\dagger}$	$+0.39478$	$+0.81795$
$(+3l'-2\lambda-\pi')$	$+0.36881$	$+0.92452$
$(+4l'-3\lambda-\pi')$	$+0.32460$	$+0.97499$
$(+5l'-4\lambda-\pi')$	$+0.25489$	$+0.99035$
$(+6l'-5\lambda-\pi')$	$+0.17480$	$+0.98215$
$(+7l'-6\lambda-\pi')$	$+0.08779$	$+0.95716$
$(+8l'-7\lambda-\pi')$	$+9.99578$	$+0.91962$
$(+9l'-8\lambda-\pi')$	$+9.90003$	$+0.87237$
$(+10l'-9\lambda-\pi')$	$+9.80135$	$+0.8174$
$(+11l'-10\lambda-\pi')$	$+9.70031$	$+0.7561$
$(+12l'-11\lambda-\pi')$	$+9.59737$	$+0.6896$
$(+13l'-12\lambda-\pi')$	$+9.49280$	$+0.6187$
$(+14l'-13\lambda-\pi')$	$+9.38687$	$+0.5440$
$(+15l'-14\lambda-\pi')$	$+9.27977$	$+0.4621$
$(+16l'-15\lambda-\pi')$	$+9.17169$	$+0.3853$
$(+17l'-16\lambda-\mu')$	$+9.06070$	$+0.3021$
$(+18l'-17\lambda-\pi')$	$+8.95284$	$+0.2167$
$(+19l'-18\mu-\pi')$	$+8.84198$	$+0.1290$
$(+20l'-19\lambda-\pi')$	$+8.73102$	$+0.0378$
$(+21l'-20\lambda-\pi')$	$+8.6180$	$+9.9489$
$(+22l'-21\lambda-\pi')$	$+8.5071$	$+9.8567$
$(+23l'-22\lambda-\pi')$	$+8.3892$	$+9.7634$
$(+24l'-23\lambda-\pi')$	$+8.2814$	$+9.6676$
$(+25l'-24\lambda-\pi')$	$+8.1654$	$+9.6002$
$(+26l'-25\lambda-\pi')$	$+8.0538$	$+9.4756$

	$a'R_{01}$	$a'a\frac{dR_{01}}{da}$
$^*e^3\cos(-l+2\lambda-\omega)$	-0.18139	-1.35665
$^\dagger ee'^2\cos(-l+2\lambda-\omega)$	-0.71402	-1.79389
$^\ddagger ee'^2\cos(l-\omega)$	-0.93244	-1.95144
$\Vert\ e\eta^2\cos(-l+2\lambda-\omega)$	$+1.35514$	$+2.40665$
$\S\ e\eta^2\cos(l-\omega)$	$+1.56543$	$+2.57043$
$^{*\dagger}e\cos(2l-\lambda-\omega)$	$+9.98823$	$+0.70447$

TABLE IV—*Continued*

	$a'R_1$	$a'a\frac{dR_1}{da}$
$e^2e'\cos(-7l'+8\lambda-\pi')$	+0.90217	....
$(-6l'+7\lambda-\pi')$	+0.86457	+1.76226
$(-5l'+6\lambda-\pi')$	+0.80557	+1.67484
$(-4l'+5\lambda-\pi')$	+0.73111	+1.60148
$(-3l'+4\lambda-\pi')$	+0.64802	+1.57523
$(-2l'+3\lambda-\pi')$	+0.59662	+1.60714
$(-1l'+2\lambda-\pi')$	+0.63801	+1.84224
$(+1\lambda-\pi')$	+0.77974	+1.83856
$(+1l'-\pi')$	+0.92443	+1.93602
$(+2l'-1\lambda-\pi')$*	+0.93706	+1.97961
$(+3l'+2\lambda-\pi')$	+0.65094	+1.93932
$(+4l'-3\lambda-\pi')$	−0.36158	+1.75312
$(+5l'-4\lambda-\pi')$	−0.99561	+0.86503
$(+6l'-5\lambda-\pi')$	−1.23150	−1.73756
$(+7l'-6\lambda-\pi')$	−1.36124	−1.08641
$(+8l'-7\lambda-\pi')$	−1.43727	−1.38807
$(+9l'-8\lambda-\pi')$	−1.47979	....
$(+10l'-9\lambda-\pi')$	−1.51569	....
$e'^3\cos(-7l'+8\lambda-\pi')$	+0.51348	....
$(-6l'+7\lambda-\pi')$	+0.47012	+1.39838
$(-5l'+6\lambda-\pi')$	+0.41162	+1.33270
$(-4l'+5\lambda-\pi')$	+0.34713	+1.29632
$(-3l'+4\lambda-\pi')$	+0.31190	+1.31836
$(-2l'+3\lambda-\pi')$	+0.33417	+1.40159
$(-1l'+2\lambda-\pi')$	+0.44469	+1.51683
$(+\lambda-\pi')$	+0.60576	+1.62587
$(+1l'-\pi')$	+0.70807	+1.70018
$(+2l'-\lambda-\pi')$†	+0.60160	+1.71297
$(+3l'-2\lambda-\pi')$	+9.88412	+1.62638
$(+4l'-3\lambda-\pi')$	−0.53788	+1.32931
$(+5l'-4\lambda-\pi')$	−0.89185	−0.94718
$(+6l'-5\lambda-\pi')$	−1.06225	−1.64883
$(+7l'-6\lambda-\pi')$	−1.16523	−1.91255
$(+8l'-7\lambda-\pi')$	−1.22011	−2.06915
$(+9l'-8\lambda-\pi')$	−1.25003	−2.17036
$(+10l'-9\lambda-\pi')$	−1.26035	−2.23523
$(+11l'-10\lambda-\pi')$	−1.2958	−2.28193
$(+12l'-11\lambda-\pi')$	−1.2778	−2.3006
$(+13l'-12\lambda-\pi')$	−1.2526	−2.3194
$(+14l'-13\lambda-\pi')$	−1.2205	−2.3142
$(+15l'-14\lambda-\pi')$	−1.1807	......
$(+16l'-15\lambda-\pi')$	−1.1313	−2.3099
$(+17l'-16\lambda-\pi')$	−1.0785	−2.2790
$(+18l'-17\lambda-\pi')$	−1.0213	−2.2624
$(+19l'-18\lambda-\pi')$	−0.9624	......
$(+20l'-19\lambda+\pi')$	−0.9017	......

	$a'R_{01}$	$a'a\frac{dR_{01}}{da}$		$a'R_{01}$	$a'a\frac{dR_{01}}{da}$
* $e^2e'\cos(2l'-\lambda-\pi)$	+0 97336	+1.98303	† $e'^3\cos(2l'-\lambda-\pi')$	+0.70988	+1.72237